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Low Costs Invite Construction

THE low costs of material and labor and the unusual efficiency of labor under economic influences like the present invite construction by energy-transmission and central-station companies. While the European war lasts this opportunity will remain. It is the most favorable combination of material and labor conditions that has existed for years or that is likely to prevail for a long time. The main reason why new construction has not been stimulated is the money market. Yet there has been a material change in the financial position. Bank reserves are strong again, rates are nominal or low for loans of short maturities, and the public has been buying securities. If central-station companies avoid heavy commitments, they can finance construction requirements on a moderate scale. With earnings affected only slightly by business unrest, companies that have the courage to go ahead conservatively will receive more than ample return for their enterprise.

Sinking-Fund Payments

PROTESTS against the provision in the accounting system of the National Electric Light Association that sinking-fund payments shall be charged to income are likely to lead to a revision. The accounting committee has reconsidered the matter and is in favor of modification. There is no uniformity of ideas or practice on this question, and substantial arguments support both the present requirement and the desired modification. Accounting systems prescribed by the various public service commissions tend to show the charge as an income deduction. The purposes of sinking funds for retirement of bond issues differ so largely that it is difficult to meet the question involved in each individual case by a policy that is applicable to all. Yet, if unnecessary complication is to be avoided, the problem can be solved best by a standard disposition of all such payments. In some instances sinking-fund payments are properly a part of fixed charges, but in others they may be met in effect by refunding. Thorough discussion is desirable, and the committee will undoubtedly try to have this take place before action is taken at the San Francisco convention.

The Government Hampers Foreign Trade

IN his address before the American Academy of Political and Social Science on May 1, abstracted in this issue, Mr. Maurice Coster gave a formidable array of governmental policies which hamper foreign trade. He suggested that the remedy is publicity. No time has ever been more opportune for this than the immediate present. Never before have the influential daily newspapers been so eager to publish articles on foreign-trade expansion. At no previous day has the country as a whole been so alert for overseas commercial opportunities. Our manufacturers are heavily handicapped because their foreign competitors, instead of being hindered by governmental acts, are substantially and progressively helped by direct governmental policies and by supporting commercial policies. Where European governments and business interests pull together, ours think it more important to avoid the appearance of evil co-operation than to build up trade. Political and party leaders have a clear duty to perform in showing the public that in this respect business interest is national interest. The electrical industry should take its part in the work.

Calculation of Induction-Motor Performance

IN his article commencing in this number, Mr. Waldo V. Lyon introduces some simplifications into the arithmetical theory of the polyphase induction machine, and especially into the separation of the leakage-impedance drop in the stator into a substantially constant no-load component and a load component which bears a simple relation to the load current. The author favors the equivalent single-phase method of presentation—that is, the retention of the terminal three-phase voltage, with the reduction of the observed line currents to their equivalent single-phase value, whereby the motor becomes virtually treated as a single-phase motor having a rotating magnetic field. This is a favorite method of treatment among designers, since it reduces the number of circuits to be considered from two or more to one and keeps the total power of those circuits in integral value before the mind. Of course, the reduced current strengths employed are in a certain sense fictitious, being equal in value to the actual line currents multiplied by a constant which depends on the number of phase leads. An alternative method of presentation is to work out the voltage, current and power, etc., for only one of the polyphase circuits. In the case of star-connected machines, this procedure may involve less use of fictitious quantities, but the powers arrived at are only fractions of the corresponding powers in the machine. Moreover, in the ordinary three-phase machine star voltages have to be substituted for delta voltages, which virtually introduces another set of fictitious quantities. Mr. Lyon's method of computation is well worthy of study by those who desire to acquaint themselves with the arithmetic of the polyphase motor and have not yet

stereotyped their own methods of computation. After a computer has become habituated to a certain beaten track in the use of formulas, it is ordinarily inadvisable for him to modify the process unless a notable simplification may thereby be secured, because the advantage of the improved process may be more than offset by the uncertainties incident to the use of a new and untried method.

Oil-Switch Explosions

The oil switch is a wonderfully effective piece of apparatus for opening a moderately high-tension alternating-current circuit quietly, as anyone will admit who tries to open similar circuits with a simple air-break switch. In the very early days of electric energy transmission the opening of the high-tension air switches of that time was avoided as far as possible. When, however, it was necessary to open a switch with a long air-break, two men were sometimes assigned to the operation, one to throw open the switch and the other, armed with a club, to bat out the long arc in the air between the opening switch points. Oil has the valuable property of smothering the arc between opening points at the moment when the current is passing through zero.

Although oil switches perform their allotted functions satisfactorily in the vast majority of cases, yet occasionally an accident may occur from the explosion of gases within either a defective or an overloaded oil-switch case. This source of danger forms the subject of an article by Mr. A. Weinberg in a recent issue of the *Elektrotechnische Zeitschrift*. The author points out that the cause of such explosions is the firing, within the switch chamber, from the arc rupture, of an explosive mixture of oil gas and atmospheric oxygen. If means are taken to prevent the formation of such a gaseous explosive mixture, it is contended that, although destructive arcs may form within the chamber, yet no explosion can take place. In order to prevent the possibility of forming an explosive mixture, it is proposed to install a nitrogen generator, permanently connected by pipes to the switch cases, in such a manner that nitrogen will automatically enter any case in which the gas pressure falls below, say, one atmosphere above normal atmospheric pressure. Each switch case is made air-tight, its working rods entering through air-tight glands, and an indicating manometer, or pressure gage, is mounted on its cover. A ventilating pipe enables the original air content to be evacuated.

It is reasonable to suppose that no explosion can occur in a chamber containing only oil gases and nitrogen. On the other hand, an arc of sufficient violence, acting on a non-inflammable gaseous mixture, is able to produce sudden rises of pressure so great as to simulate the effects of an inflammatory explosion. It would seem, therefore, that the expedient suggested by the author might reduce the probability of bursting accidents without preventing them altogether. It would be interesting to obtain experience with nitrogen-filled switch boxes in sufficient numbers to enable a reliable conclusion on this question to be reached.

The Gas-Filled Lamp in Photography

In a late issue of *Zeitschrift für Beleuchtungswesen* Dr. W. Voege reported the results of his research covering the investigation of the effect of operating standard gas-filled lamps at overvoltage so as to obtain a higher actinic output than is ordinarily available. At present the usual sources of artificial light for photographic work are the arc, usually in the inclosed form, and the mercury-vapor lamps, in both glass and quartz tubes. From the standpoint of ordinary light production the mercury-vapor quartz-tube lamp is the most efficient of these illuminants, with the gas-filled incandescent in the second place, followed closely by the mercury-vapor glass-tube lamp and at considerable distance by the various carbon-arc lamps. Dr. Voege's experiments in improving the performance of the gas-filled lamp by overrunning it are directed toward making this light source, which is very attractive on account of its cheapness and convenience, more useful in photography than has hitherto been the case.

A comparison of the artificial sources mentioned above for their actinic value reveals enormous discrepancies. Some special forms of carbon arc give enormously powerful photographic effects comparable with even the quartz-tube mercury-vapor lamp, and all are notably more actinic than the ordinary gas-filled incandescent lamp. Starting with a lamp of the last-mentioned type normally operated at 12 volts, Dr. Voege operated it at 30 per cent overvoltage, with the result of forcing down the specific consumption to a shade less than a third of a watt per hefner candle. The candle-power under this treatment rose to 250 per cent, and the actinic power a good deal more, the gain varying according to the particular character of the photographic paper or plate employed in the test. With a certain paper, for example, the actinic output of the lamp overrun by 30 per cent increased about 3.75-fold, on a fast dry plate about 2.75-fold. While these figures still leave the incandescent lamp far behind the arc lamp, they show so great an increase over the results at ordinary voltage as to overcome in no small degree the difficulty hitherto felt with respect to the use of this lamp on account of the length of exposure.

Orthochromatic plates, now coming into common use in artistic photography, differ enormously from the ordinary ones in point of the spectrum at which the maximum sensitiveness exists when the plates are used with screens to give them their full orthochromatic value. In fact, when one is dealing with a properly screened orthochromatic plate it is the brightness of the light in the visual sense which determines the exposure. It would be exceedingly interesting to compare the incandescent with the carbon and the mercury-arc lamps for this particular kind of work, such as is necessary, for example, in portraiture. Similar idiosyncrasies exist with ordinary photographic papers, some of which are abnormally sensitive to the extreme ultra-violet and hence would print with extraordinary speed under the quartz-tube lamp, while the maximum for others lies much nearer the visible spectrum in the particular re-

gion where some of the specialized carbon-arc lamps show great intensity. To work out the relative usefulness of all these artificial illuminants requires an extensive study of the performance of different photographic media. Although Dr. Voege's experiments did not include orthochromatic plates, yet he has done quite enough to show that by raising the voltage on a gas-filled lamp it is lifted into a new sphere of usefulness and becomes a most useful auxiliary in photographic working. The subject is worth further investigation which ought to be extended into fields which even the very valuable paper of Dr. Voege has not yet reached. For instance, the effect of the particular quality of artificial light used on the corrections of lenses when employed for delicate copying work is worth investigating. Ordinary photographic lenses are achromatized for the lines *D* and *G* of the solar spectrum or thereabout. Some of the process lenses are achromatized in addition for the partial abolition of the secondary spectrum, but if the inclosed carbon arc is to be used for the source, one theoretically should obtain better definition by a different lens design. In this way the subject broadens as one investigates it with ever-widening opportunities for improvement.

The Baltimore Reserve Station

Experience has taught the desirability of installing auxiliary steam equipment in connection with any large system which depends in the main upon transmitted hydroelectric energy. Reserve equipment is badly needed in case of accidents to the transmission line, now fortunately unusual but still possible, and in many instances the variability of the water-power is such as to make assistance from a steam station imperative in case of a large regular demand for energy. Such is the situation with the supply of the Consolidated Gas, Electric Light & Power Company at Baltimore. This system receives its energy regularly from the plant on the Susquehanna River, some 40 miles from Baltimore. The maximum output rating of this hydroelectric station is 82,000 kw, which can readily be reached in the periods of plentiful water, but in summer the possible output may drop as low as 9000 kw.

It is necessary, therefore, for the distributing company in so large and important a city as Baltimore to provide a considerable amount of steam-reserve equipment, running up to at least 20,000 kw even at the present rate of demand. The Baltimore company must furnish its own standby service under its arrangement with the transmission company, and hence it has in operation two steam stations. One of these is comparatively small, while the other, at Westport, Md., on a branch of the Patapsco River, had a full-load rated output of some 20,000 kw prior to the addition of the equipment described in the current issue. With the exception of a 5000-kw vertical turbine, the original plant at this point was composed of reciprocating-engine sets fed with steam from fourteen 650-hp boilers, four of them hand-fired, the others equipped with automatic stokers. It having become evident about two years ago that the requirements of a low-water season would demand a large increase of output of the reserve station, an additional plant was designed to provide for an ultimate output rating of 97,500 kw in turbo-generators. The plant now completed means the addition of only one-sixth of the final equipment, consisting of one 15,000-kw turbine and six boilers. It was necessary to enlarge the turbine room on account of the change from vertical to horizontal units and to provide an entirely new boiler room and stack. Incidentally a 500-kw horizontal turbo-generator was installed to replace the 5000-kw machine, which had been damaged by an accident.

Perhaps the chief point of interest resides in the boilers. Each is rated at a little over 1000 hp, having a total heating surface of approximately 10,000 sq. ft. The boilers complete are hung from steel channel bars in their settings. They are equipped with superheaters and are designed to carry 300 per cent of their rating when the fire is forced to the utmost. All are equipped with automatic stokers operating under forced draft and actuated by steam engines driving both the stokers and the fans. Independent connection is furnished for electric motor drive if it becomes desirable. These boilers are guaranteed for a combined boiler and furnace efficiency of not less than 74 per cent at approximately normal rating, and an efficiency of not less than 72 per cent is guaranteed when the boiler is worked at 2000 hp, with a fall to only 68 per cent when operated at 2500 hp. Furthermore, the boilers are guaranteed to develop three times the normal rating (3000 hp) for two hours, and 2500 hp continuously. Moreover, there are specific guarantees as to performance when the quick raising of steam is required—guarantees of a character extremely satisfactory, since the makers undertake, when starting with the fire banked and burning only 320 lb. of coal per boiler per hour, to push the output of steam to normal rating in three minutes and to double the normal rating in nine minutes.

The above guarantees of boiler performance mark well the difference between old and modern practice in making steam. These are the days of large boiler units and of provision for raising steam quickly to meet the requirements of a failing supply of energy over transmission lines or a sudden demand due to a rising storm. In auxiliary plants like the one here considered there is acute need of facilities for "getting up steam" rapidly. Such facilities are provided in plants of recent design, while up to within a very few years nothing of so effective a character was undertaken or would have been likely to be guaranteed. That the steam thus economically generated is not misused afterward may be judged from the fact that the guarantee on the 15,000-kw turbo-generator at full load is 13 lb. of steam per kilowatt-hour, and even a quarter of a pound less than this at 80 per cent of the full-load rating. With a plant of this degree of efficiency, auxiliary service can be brought into use at a very modest cost, and the operating company is well equipped to withstand the severest conditions imposed by a variable water supply at the source of its transmitted energy.

LETTERS TO THE EDITOR

Concentric Wiring in Great Britain

To the Editor of the ELECTRICAL WORLD:

SIR:—The opportunity for concentric wiring here depends to a large extent on the distribution conditions encountered. Most British central stations furnish direct current, distribution being invariably by the three-wire system with the neutral grounded at the generating station only. In one or two isolated cases the authorities have permitted earthing of the neutral on consumers' premises, but in large distribution systems this method is considered inadvisable, as it makes the detection and correction of faults in mains very difficult. If both poles of a concentric-wiring system have to be insulated, the advantages of the system in cost, and so on, largely disappear. The concentric system is therefore practically barred from the great majority of British electricity supply systems. By means of a motor-generator or converter a concentric installation could, of course, be isolated from the general distributing system, but the use of such a plant as this is obviously out of the question, except in very special cases.

Although not many British central stations furnish alternating-current service, there is not much difficulty in using concentric wiring with a grounded outer on such systems since the tendency is now to ground the secondaries of alternating-current systems. In the case of private plants, which generally furnish a two-wire supply, concentric wiring can also be used to an unlimited extent.

As regards cost, a concentric installation with grounded outer is less costly than any other system of wiring, excluding, of course, shoddy work, such as cheap wiring cleated to the wall or unprotected rubber wire. It is also cheaper than slip-joint tubing or wood casing. The lower grade lead-covered wiring systems are probably as cheap as concentric, but they are not so safe or durable.

One of the principal economies permitted by the use

FIG. 1—CONCENTRIC WIRING IN BRITISH GOVERNMENT OFFICES, CALCUTTA

of concentric wire is the saving in cutting plaster and woodwork and in making repairs. Concentric wiring is so unobtrusive that it can be run on moldings, and in many cases even mounted directly on the surface without being unsightly. This feature presents the great advantage that houses already built but not wired can be wired with concentric conductors at very low cost, a good reliable job being insured at the same time.

One of the largest electrical contractors in London reports that 70 per cent of his business is now installed with concentric wiring, but it should be explained that this particular firm does a very large business in private-plant equipments. A contractor whose business lies chiefly with municipal electric systems might report very differently.

The attached photographs show that the concentric

FIG. 2—CONCENTRIC WIRING IN BRITISH GOVERNMENT OFFICES, CALCUTTA

system is permitted in British government work, which is generally of a high standard. The rooms illustrated are the government offices at Calcutta, India.

It is now six years since the Stannos concentric system was first brought out, and from the manufacturers' returns this system must be rapidly gaining favor, as the yearly increase in the output of Stannos material is very great.

Special fittings are not required, apart, of course, from the fixing plates for ceiling rosettes, etc. Even these are not necessities, but they are useful and economical.

One large contractor, who uses a considerable quantity of concentric wiring, states that even if both wires have to be insulated, as on three-wire direct-current distribution systems, the cost of concentric construction is only about 10 per cent greater than wood molding and is even 20 per cent cheaper than screwed tubing.

A company here, called the "Fixed Price Light Company," which contracts with central-station undertakings for energy supply in bulk, and then wires small cottages and workmen's dwellings and undertakes the collection of bills, etc., uses concentric wiring exclusively, all of the work being run on the surface of walls in the same way that cheap gas-pipe installations are made in England. Such gas piping, by the way, is generally made of a composition lead pipe, and its liability to damage and gas leakage is greater than the liability of concentric wiring to injury or short-circuit.

In England, as elsewhere, there is a growing disposition to substitute alternating-current distribution for direct current, especially where large cooking and heating loads have to be taken care of, and the increased use of alternating current for this purpose will undoubtedly have the effect of increasing the use of concentric systems of wiring.

Although considerable opposition seems to exist on

the part of electrical contractors in the United States to the use of cheaper forms of wiring, in Great Britain the same opposition does not exist, and some of the most enthusiastic users of cheap wiring systems are the wiring contractors. This is hardly surprising, because obviously the more cheaply an installation can be put in for the consumer, the more wiring work the contractor is going to get, and although the profit on his individual job may not be so large, he will get many more jobs and consequently a bigger total net profit.

In Great Britain central-station engineers are always on the lookout for anything that will reduce the cost of electricity for the consumer, while at the same time maintaining a high standard of safety, for the disastrous results from cheap installations and apparatus are only too well realized.

A. HUGH SEABROOK,
General Manager St. Marylebone Electric Supply.

London, England.

American Versus Continental Wiring Standards

To the Editor of the ELECTRICAL WORLD:

SIR:—On opening the pages of your Dec. 5 number, just received here at Chengtu, in West China, I was much interested in the article comparing American and European wiring rules. In confirmation of your editorial on the subject, I am appending hereto an account of our experience.

At present there is in Chengtu no electric wiring according to modern standards, if we except the lines of the Chinese company furnishing lighting for the city. This company appears to have a set of wiring rules all its own, for it uses a No. 20 thin, braid-covered, rubber-insulated wire attached by pony telephone glass insulators to brackets on either side of a 6-in. pole for the feeders of its 3000-volt, three-phase system. This construction has been in service for a year in a climate averaging about 90 per cent humidity, and so far the lamps have not been out once nor has anyone had a shock. These same wires were used as feeders on the company's old 230-volt direct-current system, and although the drop between the station and a point only 500 ft. away was only 45 volts, the officials are wondering why they cannot keep the lamps burning brightly.

When it came to installing the wiring for a small isolated plant, the reader will see from the above that we had few precedents to guide us. As all the wiring must needs be open, only open cleat and conduit wiring could be considered. As conduit wiring has a bad reputation in these parts, owing to condensation of moisture in the bends, causing short-circuits, it was used only in the service runs for motors where there were no bends. In all the open-cleat wiring the American rules were followed. After the entire order had been placed the article by Mr. S. E. Doane on "Kuhlo" wire came to our notice. For an experimental try-out of this wire, one of the dwellings and a hospital were changed to this form of construction. The material was ordered from the catalog of the German manufacturer, obtained here from its representative, a non-technical man. We specified sizes to correspond to our wiring rules, but at the suggestion of the representative that we were specifying much larger wire than his principals used for the same conditions, we finally ordered wire having a cross-section of 1.5 sq. mm where we were to use No. 14 B. & S. and of 2.5 sq. mm where we were to use No. 12 wire. Imagine my surprise when we were told by the home engineering office that such large sizes were not carried in stock and that it was sending us smaller sizes. Accompanying this letter was the following comment on the company's practice of wiring:

"Use duplex 1-sq. mm wire for wiring room interiors where circuits carry a maximum load of 10 amp to one circuit. It is a common rule that not more than ten lamps should be connected to one circuit, and for this purpose duplex 1-sq. mm wire is quite sufficient. For connecting single circuits where these are at some distance from the distribution board or main distribution wires feeders duplex 1.5-sq. mm should be used. For main feeders duplex 4-sq. mm or duplex 6-sq. mm are recommended. In case these sizes should be insufficient, two or more duplex wires should be taken."

Translating the foregoing into our B. & S. gage, this means that the firm recommends a No. 17 wire inside a single room, and a wire a little smaller than a No. 15 to connect several rooms to the distribution board. That this is not a ruse to capture Oriental trade will be seen by reading the manufacturer's own home rules, for under these all his recommendations are well within the limits.

To check the practice and to see whether the drop in voltage was larger than the 1-volt drop we were allowing in our circuits, we selected our longest and heaviest loaded lighting circuit and made the following calculation:

Length of circuit = 113 ft. total; to load center = 56 ft.
Total load connected = 260 watts; pressure = 105 volts; current = 2.48 amp.
Then cross-section in circ. mils

$$= \frac{22 \times I \times L}{V}$$

$$= \frac{22 \times 2.48 \times 56}{1}$$

= 3050, or between Nos. 15 and 16, B. & S.

The 1.5-sq. mm wire suggested by the Germans for this service is about 2960 circ. mil, about equivalent to No. 15 B. & S. As this was our longest circuit, we naturally decided to keep the wire sent. In so doing we saved $65 over what would have been required with the larger wire. As this was some 30 per cent of the cost, not including freight, it represented a saving not to be ignored.

Comparing the cost had our own rules allowed us to use No. 18 wire in rooms and No. 16 to connect up rooms, we arrived at the following conclusions:

7,200 ft. of No. 18 in rooms and 3,000 ft. of No. 16 in circuits, cost at 15-cent base	$76.25
Freight on 134 lb., at 3.5 cents minimum	4.70
Total	$80.95
10,200 ft. of No. 14 all told, cost more than	$105.87
Freight on 204 lb.	7.15
Total	$113.02

Thus the extra cost of using No. 14 wire was $32, or more than 30 per cent.

When to this $32 saving there is added 30 per cent for expenses and 10 per cent for duty and insurance, we have a sum which to the Chinese mind is well worth saving and which in a way represents the margin that the Continental exporter has within which to give equal service. This comparison also shows why we here are all inclined toward the use of the Continental rules in our electrical work in the Orient.

Another practice we find here is the use of stranded conductors for sizes even as low as No. 14, the English equivalent of which is three No. 20 wires stranded. This looks to us to be a waste of money, but it is certainly more convenient to handle such wires. The smallest standard stranded conductor consists of three No. 25 wires or the equivalent of a No. 19 B. & S. wire. I do not know the use of this wire, but it is given in all English catalogs and is evidently used in fixture work.

H. K. RICHARDSON,
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Chengtu, West China.

Mr. Coster on Foreign Trade Obstacles

In discussing "Existing Obstacles to the Extension of Our Trade with Central and South America," before the American Academy of Political and Social Science at Philadelphia, on May 1, Mr. Maurice Coster, export manager of the Westinghouse Electric & Manufacturing Company, said that the country need not look for any great improvement in trade with Central and South America until the European war has been brought to a close. English bankers have been forbidden by their government to participate in financial undertakings outside of Great Britain. Undoubtedly similar restrictions have been imposed by the governments of other warring nations.

The Central and South American countries, with the possible exceptions of the Argentine Republic and the United States of Colombia, are not in a position to finance new enterprises. Some of the American bankers have taken commendable lead in establishing branches in some South American countries. Mr. Coster doubts, however, if these bankers, under existing conditions, will be justified in extending their business in those countries to any considerable extent or to finance enterprises as was done formerly by foreign banks.

In order to insure permanent success and an increase in export trade, the statutes relating to this subject must be revised. For instance, Mr. Coster added, there should be a law admitting to American registry all vessels, whether built in the United States or not, when owned chiefly by American citizens or by American corporations and, when engaged in foreign trade with the United States, such vessels should be exempt from the provisions of the American navigation laws. The special regulations appertaining to the treatment of crews, to safety appliances, etc., of such vessels should conform to those of the merchant marine of the great maritime nations. In the past ships of certain foreign nations have not only discriminated against merchants of this country in rates, but they have deliberately delayed delivery of American cargoes in the interest of their own nationals. Frequently demurrage charges incident to such wilful delays have been paid by foreign associations or governments.

Mr. Coster declared that the Seamen's bill should be so amended as to apply only to coastwise trade and that of the Great Lakes. It is necessary to have vessels running directly between ports of the United States and those of Central and South America, providing the very best of passenger accommodations in order to induce Latin-Americans to visit here so that better acquaintance may develop. Before the war they usually went to Europe. Those who came here had to take additional time to cross the Atlantic twice or endure inferior accommodations.

Amend the Sherman Act

Railroads and steamship lines should be permitted at all times to issue through bills of lading to foreign countries and to make special rates to meet foreign competition. Railroads should make preferential freight rates on shipments of manufactured articles from inland points to the coast. This is the common practice in foreign countries. The Sherman act, Mr. Coster declared, should be amended in order to exclude from its provisions foreign business. The amended law should be so clear as to leave no doubt as to its interpretation. Laws relating to drawback, being a refund of duties on materials used in the manufacture of articles exported, should be amended so as to encourage foreign trade and to conform to similar laws already in successful operation in foreign countries for some years past.

Furthermore, Mr. Coster said, Congress should appropriate sufficient funds to permit the United States to be represented by able men in Central and South America. Men are needed of the class employed by foreign governments, who are able to make reliable reports on the activities and methods of foreign competitors and the conditions surrounding proposed industrial undertakings, reports on which the banks can place absolute reliance when they are requested to assist in the financing of enterprises. Some of these foreign representatives at present act in the capacity of "trade spies" and furnish their governments with information concerning the business done by subjects of competing countries. They even go to the extent of supplying their governments with detailed copies of invoices of American manufacturers made collectible through foreign banks.

Definite Governmental Trade Policy

This government should adopt a definite policy favoring foreign trade. All present laws and policies which operate to the benefit of foreigners at the expense of American enterprise should be repealed or amended. The government should use its influence to induce all Central and South American republics to make their tariff laws dependent on specific duties, based on weights or otherwise, and not on "ad valorem" values. The American exporter suffers very much from the illegal practice of some foreign manufacturers who swear to undervaluations amounting to as much as from 40 to 60 per cent of the true invoice value, thus placing American exporters who will not condescend to these fraudulent practices at an unfair disadvantage.

For effective competition with foreign countries, Mr. Coster continued, our banks should be prepared to assist in financing Central and South American governments and deserving enterprises in those countries just as foreign banks have done for years with scarcely any losses. The banks cannot be expected to do this under the present governmental policy. Foreign manufacturers have in the past investigated foreign enterprises and, upon favorable report of the government agent or other responsible party, have been able to secure the assistance of their banks in financing.

Mr. Coster told his hearers that this country must not deceive itself by expecting that the war will so cripple European competitors as to make their competition negligible in the future. It must not expect to take away much of the trade formerly held by foreign competitors, chiefly Germans and British, unless our manufacturers are put as nearly as possible on an equal footing with them.

How Newspapers May Help

The American press, with praiseworthy activity, has taken a great interest in foreign trade with practically the only result of increasing applications for imaginary positions in connection with export business, Mr. Coster said.

One of the first things to be done in order to bring about the somewhat seemingly radical changes of laws and policies suggested is to educate the press. Show it what is really required to increase foreign trade and have it in turn post the masses, who, together with the newspapers, should influence necessary legislation. The press must make the American public realize that every dollar exported in merchandise makes the American nation so much richer and that the American laborer will be benefited to a proportionate extent. The people must also be made to understand that foreign trade is absolutely necessary as a "filler in" in times of depression.

The press should be encouraged to write leading articles on the proposed changes and to agitate the matter before the public in such a vigorous way as to make the laboring man understand that what is suggested is in

his interest. Voters should use their influence with representatives in Congress and with the government to bring about new laws and policies. Representatives of the press should interview leading exporters who understand foreign business and obtain their views and reasons for wishing to cause the new conditions. Mr. Coster explained carefully that no special privileges and no subsidies are asked, but, on the other hand, the business should not be hampered by unjust and unnecessary regulations. In most instances the difference in cost between American and European labor can be overcome by our more extensive and ingenious methods of manufacture, but manufacturers should not be required to do more than is involved in these.

New Rates of New York Edison Company

The New York Edison Company has issued a letter to customers regarding the changes in rates and service which took effect on May 1. As stated previously, the maximum rate is reduced from 10 cents to 8 cents per kw-hr. in the territory served, with the exception of a small section of the Bronx. An abstract of the letter follows:

Besides the change in rates referred to, material reductions are also to be made in the wholesale and the so-called power schedules, contributing still further to the economical supply of electric energy for large buildings and manufacturing purposes. The schedule for break-down service will be reduced.

The new prices will not include the supply of incandescent lamps or the care or maintenance of arc lamps. Where lamp service is desired, it will be provided for the so-called "renewal" lamps, under a separate agreement, for 0.5 cent per kw-hr. Where this service is taken, other standard lamps will be provided at prices which allow for the one-half-cent payment.

A further change is the discontinuance of all submetering. As a matter of convenience, meter service of the past has included an unlimited supply of meters, through which possibly has grown the practice of submetering. During a recent investigation by the Public Service Commission this practice, so far as this company may have contributed to it through the free supply of sub-meters, has met with severe criticism by the commission, and its abandonment seems the only proper course.

The new schedules for general, "power" and wholesale rates are shown in the accompanying figures.

General rate:

This contract includes the supply of electricity only; care of the installation, supply of lamps or the trimming of arc lamps are not included hereunder.

	Monthly Consumption, Kw-hr.	Or Daily Consumption, Kw-hr.	Cents
The first	900	29.589	8
Next	100	3.287	7
Next	200	6.575	6
Next	300	9.863	5
Next	400	13.150	4.5
Excess over	1900	62.464	4.25

Power rate where general rate is not advantageous:

	Monthly Consumption, Kw-hr.	Or Daily Consumption, Kw-hr.	Cents
The first	450	14.794	8
Next	100	3.287	7
Next	1350	44.383	6
Excess over	1900	62.464	4.25

The power rate is not available for lighting service.

Wholesale rate:

This contract includes the supply of electricity only; care of the installation, supply of lamps or the trimming of arc lamps are not included hereunder.

	Kw-hr.	Cents per Kw-hr.
For the first	75,000 consumed in each yearly period	5
For the next	100,000 consumed in each yearly period	4
For the next	150,000 consumed in each yearly period	3
For the next	775,000 consumed in each yearly period	2.5
Over	1,100,000 consumed in excess in each year	2

Break-down service:

The guarantee under the break-down service schedule has been reduced from $30 to $24 yearly. The more essential features of the new schedule follow: In consideration of the maintenance of the service as a reserve, auxiliary or breakdown to a private electric generating plant, there will be a service charge of $24 annually for each kilowatt of maximum demand for which the contract is made. The agreement is to continue for one year and thereafter until terminated on thirty days' notice, and electricity may be consumed at the most favorable rate of the class within which the service falls, without additional cost.

The so-called power schedule is designed for small consumers of energy for motor service. When the monthly consumption reaches 1900 kw-hr. the power and general schedules merge, and thereafter the rates are identical. Should it be to the advantage of the consumer to combine under the general rate the power consumption in any monthly period, the company will do this automatically. The company does not undertake so to substitute the wholesale rate, or, vice versa, the general rate for the wholesale. This action must be taken by the consumer, who to obtain the rate assumes certain guarantees which could not be assumed on his behalf by the company.

The guaranteed use under the wholesale schedule is 75,000 kw-hr. annually in Manhattan and 60,000 kw-hr. annually in the Bronx.

The new wholesale schedule cannot be made effective until a new contract has been made. This also will apply to other contracts under which guarantees must be made by the consumer. The new general and power schedules, however, will be applied automatically to contracts of those classes, unless the consumer desires that a new contract be executed. In this event the company asks to be notified in writing and in the absence of such notice will assume that the consumer desires continuance of the existing contract under the modified schedule.

Owing to improvements in incandescent lamps of larger sizes, arc lamps are rapidly disappearing from service. For the present at least customers who desire to continue the use of arc lamps for general illumination may have them trimmed as usual at 0.5 cent per kw-hr., as with the incandescent lamps of the "renewal" types. The substitution of incandescent lamps is suggested, however, as they give more illumination with materially lessened use of energy. Flaming, photographic and motion-picture arc lamps and arc-lamp service for buildings in course of construction are not included in the standard lamp service.

Many customers may not desire to continue submetering. Where this service is to be continued, however, the present meters may be purchased by the consumer and a general meter will be installed at the service for recording the entire supply of the premises. All bills will be rendered upon the reading of this general meter belonging to this company.

Owing to the practice of taking meter readings, there can be no exact division of the energy consumption in the general and power classes between the April and May portions of bills rendered during May. The company will divide these bills in proportion to the number of days occurring in each month, charging the former rate for the April period and the new rate for the May period. The wholesale meters will be read on May 1

and an exact record will be available upon which to divide bills for service of this class.

The agreement for the supply and renewal of incandescent lamps, addressed to the company, says in part: "The amount is to be based upon the number of kilowatt-hours represented by your monthly bill for lighting purposes and is to be paid in connection with the monthly bill. It is understood that standard arc lamps may be cared for under this agreement. This agreement is to continue in effect during the term of the contract for the supply of electric light unless sooner terminated by either party hereto by thirty days' notice in writing. It is further understood and agreed that the incandescent lamps or any other devices furnished under this agreement shall remain your property and may be removed by you upon the termination of this agreement."

Effect of the War on Foreign Companies

At the fifteenth annual general meeting of the British Westinghouse Electric & Manufacturing Company, Ltd., of London, England, Mr. J. Annan Bryce, M.P., chairman of the company, spoke of the effect of the war on the business. He said in part: "The net profit is about £45,000 more than that of 1913. This excellent result is caused mainly by increased efficiency. The profit of the year is almost entirely derived from contracts entered into before the war, most of it, indeed, on contracts made in 1913. As a matter of fact, we have already suffered and are likely to suffer still more from the war, though its injurious effects are not apparent in the accounts of 1914. The amount of net profit earned is just sufficient, if we had divided right up to the hilt, to have allowed a distribution of 15 per cent on the preference capital; but in the opinion of the board it is much wiser, with the present uncertain outlook, to continue the policy of strengthening our resources by building up reserves. We have accordingly added £50,000 to general reserve, written £25,000 off good-will, and carried forward a rather larger sum than last year.

"The sudden outburst of war in the beginning of August perturbed our industry, as it did all others. As the autumn went on the stoppage of business with Germany began to make itself felt, and orders were given to us in replacement of canceled German contracts. At the same time, the War Office and Admiralty, to which we had offered our services at the outbreak of war, placed with us orders for various goods, and we also took sub-contracts from other firms to assist their deliveries. Owing to these causes the volume of orders, which at the end of July had been 27 per cent behind, finished up at Dec. 31 only 17 per cent behind that of 1913. So far, therefore, as mere volume of business is concerned, the war has rather improved our position. The mere volume of orders taken in any year or their character does not affect in any considerable degree the profits of that year but has an important effect on subsequent periods.

"The annual report alludes to our acquisition of our American friends' interests in the French and Italian Westinghouse companies. We consider that the bargain is a good one for us. We have of late years had ample opportunity of seeing the working both of the French and Italian companies, and formed the opinion that their want of success hitherto has been due to conditions which we and our American friends are confident that we shall be able to improve."

The results of operations of the Grosskraftwerk Franken A. G., of Nuremberg, Germany, for the year ended Dec. 31, 1914, according to its annual report, were satisfactory in spite of conditions caused by the war. There was a decrease in demand for energy at the beginning of the war, but this condition has gradually improved. Expenses have been greatly increased owing to the price of raw materials and to the support granted to employees now at the front. Prior to the outbreak of hostilities the company had increased the rating of its plant to 30,400 kw. Its output in 1914 was 33,350,390 kw-hr., as compared with 17,200,000 kw-hr. in 1913. The surplus for the year, including $6,183 from the previous year, was $134,950. The net profits were $64,912. The company declared a 5½ per cent dividend.

I. E. S. Nominees

The board of nominations for the Illuminating Engineering Society has selected the following as nominees for officers for the 1915-16 term:

President, Dr. C. P. Steinmetz, Schenectady, N. Y.; vice-president from New York Section, Mr. Clarence L. Law, New York; vice-president from Pittsburgh Section, Mr. J. L. Minick, Altoona, Pa.; general secretary, Mr. Alten S. Miller, New York; treasurer, Mr. L. B. Marks, New York; directors, Messrs. W. A. Durgin, Pittsburgh, M. Luckiesh, Cleveland, and J. Arnold Norcross, New Haven, Conn.

The nominating committee for the New York Section of the society has selected the following nominees: Chairman, Mr. D. McFarlan Moore; secretary, Mr. Norman D. Macdonald; managers, Messrs. Thomas M. Ambler, L. H. Graves, W. F. Little, E. R. Treverton and Herbert Whiting.

The ballot for officers of the Philadelphia Section is as follows: Chairman, Dr. George S. Crampton; secretary, Mr. L. B. Eichengreen; managers, Messrs. George S. Barrows, Douglass Burnett, Clarence E. Clewell, R. B. Ely and C. E. Ferree.

The following selection of nominees has been made by the nominating committee of the Chicago Section: Chairman, Mr. E. W. Lloyd; secretary, Mr. O. L. Johnson; managers, Messrs. A. O. Dicker, H. M. Frantz, C. A. Luther, A. H. Meyer and F. A. Rogers.

The following slate has been issued by the New England Section: Chairman, Dr. Louis Bell; secretary, Mr. S. C. Rogers; managers, Messrs. J. W. Cowles, W. B. Lancaster, George P. Smith, Jr., H. F. Wallace and R. C. Ware.

The Pittsburgh Section has made the following selection of nominees: Chairman, Mr. Lewis J. Kiefer; secretary, Mr. R. H. Skinner; managers, Messrs. Henry Harris, H. S. Hower, Harold Kirschberg, H. H. Magdsick and G. W. Roosa.

Electricians' Licensing Bill in Massachusetts

As a result of conferences between the Massachusetts Electric Lighting Association and representatives of labor interests, a bill has been substituted in the Massachusetts Senate providing for the licensing of master and journeymen electricians. The bill orders the Board of Gas and Electric Light Commissioners to appoint three examiners of electricians by July 1, 1915, to have general supervision of licenses. A master's certificate and a journeyman's certificate are defined at length in the bill (Senate No. 511), and public utility corporations and municipal plants are exempt from its provisions. A journeyman's license under the bill requires that the applicant shall either pass an examination by the licensing board or have gained his livelihood at the occupation of an electrician for the five consecutive years next prior to his application, and the same time requirement applies to master electricians.

Enlarging a Steam Reserve Station

Problems Involved in Rehabilitating the Consolidated Gas, Electric Light & Power Company's Westport Station

BY JAY C. LATHROP

AMONG the problems now before the financiers and engineers in charge of electric properties in various parts of the country is that of the standby station, or steam auxiliary to a hydroelectric station. From one point of view it is important that the investment in a station of this kind be kept as low as possible, for in many cases these stations will be operated but a few weeks during the year. On the other hand, the installation of labor-saving apparatus wherever possible is almost a necessity because of the difficulty experienced in securing even unskilled labor for the short period during which the station is in operation, which usually occurs at a time in the summer when construction work is in full swing.

An addition to a plant of this kind was recently built by the Consolidated Gas, Electric Light & Power Company of Baltimore on a property situated on an arm of the Patapsco River at Westport, Md. This company receives the greater portion of its electrical energy over two transmission lines from the hydroelectric station of the Pennsylvania Water & Power Company at Holtwood, which is about 40 miles from Baltimore, on the Susquehanna River. This station has a maximum rating of 82,000 kw, but during the summer months the output may fall as low as 9000 kw on account of low water. The deficiency which had to be supplied by steam power in one year during low water amounted to about 20,000 kw, and it is expected that this will increase from year to year.

The contract between the two companies is such that the Consolidated Gas, Electric Light & Power Company supplies its own standby service, and it is probable that arrangements will be made for it to supply the deficiency for the Pennsylvania Water & Power Company when the load supplied to other customers exceeds the minimum output of the Holtwood plant.

Auxiliary Steam Stations

The Consolidated Gas, Electric Light & Power Company has in operation two steam stations, one at Gould Street with a maximum output of 6000 kw and one at Westport, which prior to the present addition had a maximum output of about 20,000 kw. The prime movers at Westport were five reciprocating engines and one vertical Curtis turbine rated at 5000 kw. The latter machine has since been replaced by a 7500-kw horizontal-type Curtis turbine using the original condensing equipment.

The old boiler house has ten 650-hp Babcock & Wilcox hand-fired boilers, four 650-hp Babcock & Wilcox boilers and four 750-hp Edge Moor boilers equipped with Taylor stokers.

Some very interesting tests were made with the Edge Moor boilers in 1913. In these tests the boilers were operated on 318 per cent of normal rating and were also brought up from a banked fire to 100 per cent rating in three minutes and to 200 per cent rating in nine minutes.

Early in the summer of 1913 it was evident that additional generating equipment must be installed at Westport ready for service during the low-water period of 1914. About the middle of August, 1913, a contract was made with the General Electric Company to furnish and install a turbo-generator with a rating of 15,000 kw, the machine to be ready for operation by June 1, 1914. This date was set early in the season to allow for unforeseen delays and for testing and adjustment before placing the unit in commercial operation.

As it was also necessary to install greater boiler capacity, plans for a new boiler house were prepared, and during the fall of 1913 contracts were awarded for the building, boilers, condensers and auxiliary apparatus.

A comprehensive layout was made providing for an ultimate station equipment in turbo-generators of 97,500 kw and a new boiler house of 36,000 boiler-hp. One-sixth of the latter was built in 1914, containing six 1000-hp Edge Moor boilers, pumps, heaters, etc.

Main Boiler-Room Structure

About seven years ago a new reinforced-concrete turbine room, about 48 ft. wide by 100 ft. long, was constructed. In connection with this construction a proposed new boiler house had been built of similar material to a point level with the main boiler-room floor, 14 ft. from the ground. As the boilers purchased were

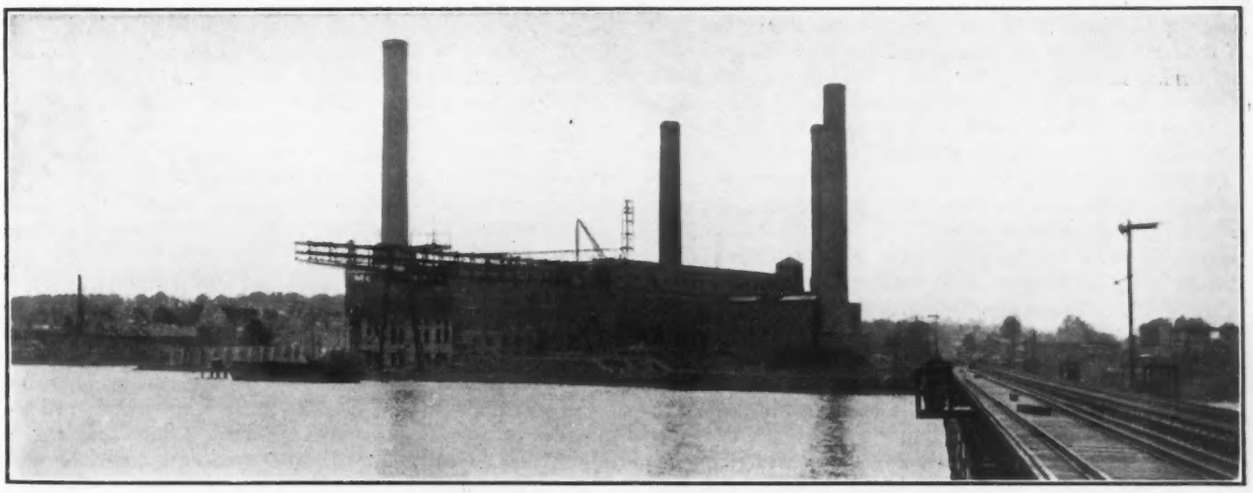


FIG. 1—WESTPORT STATION AND EXTENSION FROM PATAPSCO RIVER

much larger than this structure would accommodate, and as it was also found necessary to raise the main turbine-room floor to a point 18 ft. above the basement, this old reinforced-concrete work was removed. Owing to the narrow width of the turbine room, which had been designed for the vertical-type Curtis turbine, it was necessary to cut an opening in the south wall of the room and set the 15,000-kw unit partly through this opening. The bay between the first boiler and the turbine room was then made 20 ft. wide, so that the future extension of the turbine room could be widened 6 ft. or 8 ft. and this bay reduced the same amount.

The coal bunkers are of reinforced concrete supported upon I-beams and steel girders and are of a size sufficient for two or three days' supply of coal. Numerous walkways and stairways are provided in the boiler room so that all valves, machines, coal scales, etc., above the main floor are readily accessible. Monitors placed over the coal bunkers are provided with windows for light and ventilation. A portion of the main roof is 6 ft. or 8 ft. below the general roof level. Continuous sash is used around this depression, so that the interior of the boiler room will be well lighted even after the extensions are made.

A Custodis radial brick chimney weighing about 1200 tons is supported upon steel girders at the roof level. It is 215 ft. high above the girders by 25.5 ft. at the base, has an internal diameter of 20 ft. 2 in. for the full height, and is lined with firebrick for 35 ft. above the base. This chimney will care for the gases from twelve 1000-hp boilers. One line of breeching, consisting of ¼-in. steel plates, connects each set of three boilers to the base. The chimney was carried on the steel frame so that the space below could be utilized for pumps and other auxiliaries. The boilers and boiler-feed pumps are installed on the main floor, while the basement is divided into several rooms by tile partitions. In the center bay below the stack is a pump room containing two service and two heater pumps. Adjacent to this are a locker room and a toilet room. The rest of the basement is taken up by a storeroom, ash tracks and fan rooms. The four fans and engines that furnish air to the stokers are arranged in sets in such a manner that each pair of engines can be inclosed in a separate room.

Reinforced-concrete intake and discharge tunnels with a section 10 ft. by 12 ft. inside were built for cooling water. The intake tunnel is connected with a screen well just outside the building. The rectangular section of the discharge tunnel also stops at a point about even with the outside wall of the screen well. From this point on, each tunnel consists of two circular reinforced-concrete pipes with an internal diameter of 9 ft. These pipe tunnels are carried to the bulkhead line, about 250 ft. from the boiler house proper, and diverge so that the openings are about 100 ft. apart.

The discharge tunnel will not be used until another unit is installed as the two condensers now in place are connected to a discharge tunnel which was originally built under the basement of the turbine room. This tunnel was too small for the ultimate rating of the station, and because of a mat of heavily reinforced concrete on piles, which formed the bottom of the tunnel as well as supports for machine foundations, it was deemed more difficult to enlarge this tunnel than to build a new one under the new boiler room. Just outside the building this tunnel is connected with the discharge from the engine room, and the two are connected to a single reinforced-concrete pipe of 9-ft. inside diameter.

The foundations for the two machines were built on similar lines, consisting in each case of three transverse concrete walls and two longitudinal pairs of steel beams arranged to carry the flanges of the base casting. The concrete walls for the 7500-kw unit rest directly on the foundation for the old vertical Curtis, which was taken down to a point flush with the turbine-room basement floor. The walls for the 15,000-kw unit rest on the concrete mat above mentioned. One end wall came directly

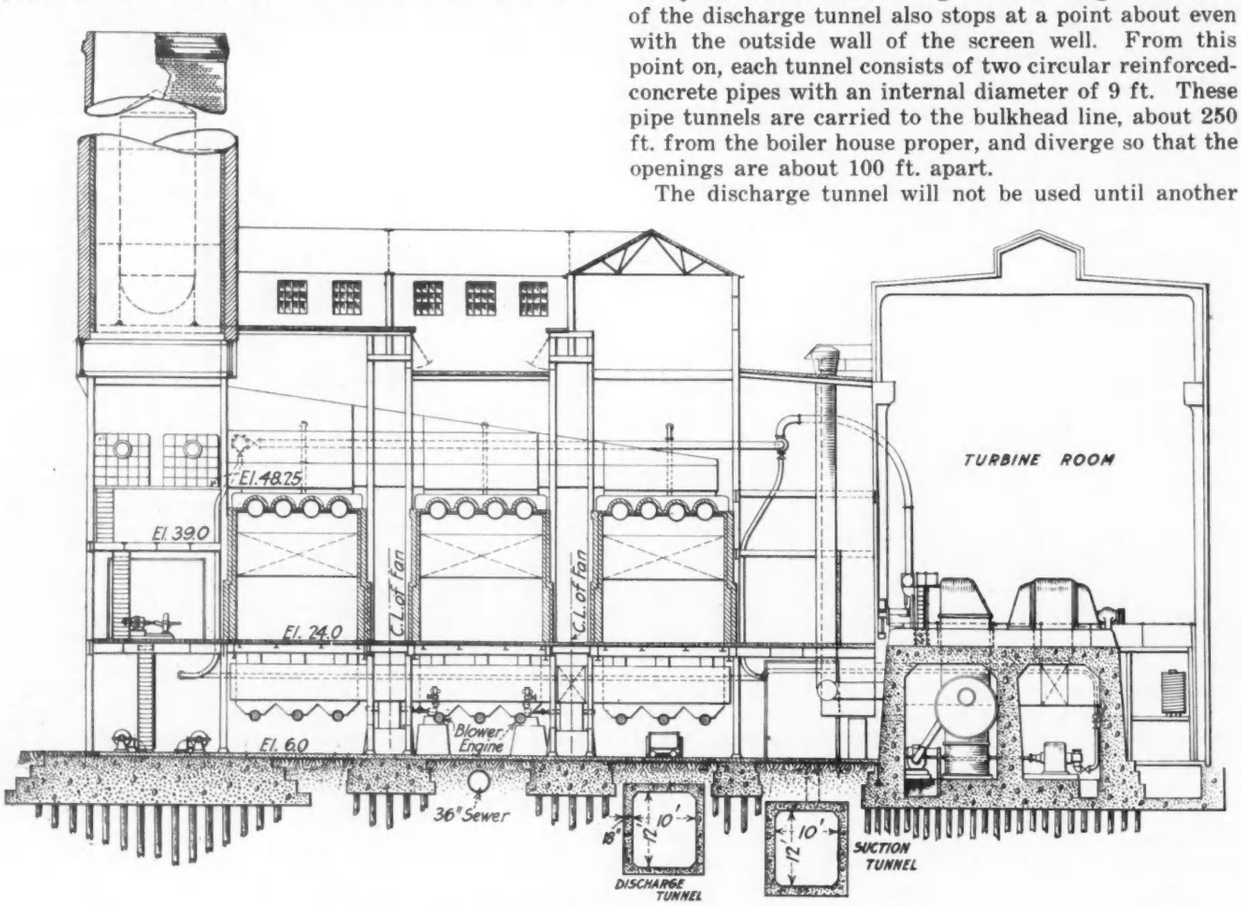


FIG. 2—LONGITUDINAL SECTION OF BOILER HOUSE NO. 3

under two of the concrete columns and the building wall. This section was removed, and the column and wall were supported on a steel girder directly over the steam end of the machine. Between the foundation walls is a pit 3 ft. deep, in which are placed the small turbines, air pumps and removal pumps for the condenser.

Turbo-Generator No. 7

The 15,000-kw turbo-generator is a twelve-stage machine and covers a floor space 40 ft. long by about 18 ft. wide over all. The exact dimensions of the base plate are 36 ft. 4½ in. long by 17 ft. 3 in. wide. The height over all is 13 ft. 1⅝ in. The total net weight is 513,600 lb., while the weight of the heaviest part is 147,000 lb.

The following are the calculated weights of the various parts of the turbo-generator:

	Lb.
Base, turbine end section	17,600
Base, middle section	26,500
Base, generator end section	28,450
Turbine rotating element with diaphragm disks	45,000
Turbine rotating element in shipping cradle	57,000
Turbine shell, each half	12,800
Exhaust casing, upper half	20,000
Exhaust casing, lower half	33,000
Turbine head, without valve chest	11,000
Heaviest nozzle ring, each	1,000
Heaviest diaphragm, each half	2,700
Heaviest bearing, each half	1,750
Heaviest standard end cap	6,000
Steam strainer	1,100
Throttle valve	3,800
Steam chest with valves	5,000
Relief valve	900
Generator rotating element	75,000
Generator	147,000
Total weight of shields	18,000
Total	513,600

The turbine is provided with a 14-in. steam inlet, while the exhaust opening to the condenser is 10 ft. 9 in. by 7 ft. 6 in. with the corners rounded to a radius of 2 ft. The base is anchored to the foundation by twelve 2¼-in. bolts.

The steam consumption at 175-lb. steam pressure, 100 deg. of superheat and a vacuum of 1½ in. absolute was guaranteed by the builder, as follows: Under a load of 7500 kw., 13.6 lb. per kw-hr.; under a load of 12,000 kw, 12.75 lb. per kw-hr.; under a load of 15,000 kw, 13 lb. per kw-hr.; under a load of 18,000 kw, 13.75 lb. per kw-hr.

This guarantee covers all leakage and losses in the turbine and generator, including the energy required in the field for excitation and for supplying air for ventilation by means of the rotor fan. At 200-lb. steam pressure these economies will be increased by 2 per cent.

Oil for the bearings is circulated at the rate of 30 gal. per minute by means of a gear pump attached to the turbine shaft, a reservoir in the turbine base having a storage capacity of 375 gal. The bearings are cooled by circulating water through pipes embedded in the babbitt, 35 gal. per minute being passed through these pipes from the general service lines. The oil is further cooled in a tank through which additional water lines are passed.

The generator, with a continuous output rating of 18,750 kva, 80 per cent power-factor, is a two-pole machine wound for twenty-five cycles, three-phase, 13,200 volts.

The temperature at an output of 18,750 kva is guaranteed not to exceed 75 deg. C. when the temperature of the cooling air is not above 25 deg. C. Cooling air is required at the rate of 45,000 cu. ft. per minute, and a duct is provided for this purpose so that cool, clean air is taken from a point above the roof level. The excitation required is 85 kw at 125 volts. The insulation was tested at 30,000 volts.

Three reactance coils were furnished with this machine, which were installed on a gallery between the basement and main floor of the turbine room. The rheostats were placed just below these coils. The leads from this machine are connected directly to the 13,200-volt busbar in the switchboard room for the old station, additional oil switches and wiring for this purpose having been installed. Energy for excitation is taken from an existing 125-volt bus in the old station.

Owing to the great weight of the armature, it was found necessary to ship the coils separately and wind this armature on the job. As the overhead crane in the turbine room was limited to 40 tons, it was necessary to place the armature by blocking up and raising one side at a time.

Condensing Equipment for 15,000-kw Turbine

The condensing equipment for the above turbine has numerous interesting features, many of which haye never before been adopted in this country. Owing to the limited space available in the turbine room, it was necessary to secure apparatus of the utmost compactness.

A complete outfit from the exhaust flange of the turbine, including atmospheric relief valves and air piping, was furnished by the C. H. Wheeler Manufacturing Company. The condenser proper consists of a horizontal combined parallel flow and counter current jet condenser shell, 10 ft. in diameter and 20 ft. long over the flanges. The shell contains two injection pipes 22 in. in diameter parallel to the center line of the condenser, into which are fitted a series of spray nozzles and deflector plates arranged in such a manner as to form interlocking sprays. One end of each pipe is fitted with an inspection cover, and the other end is connected with an injection line from the intake tunnel.

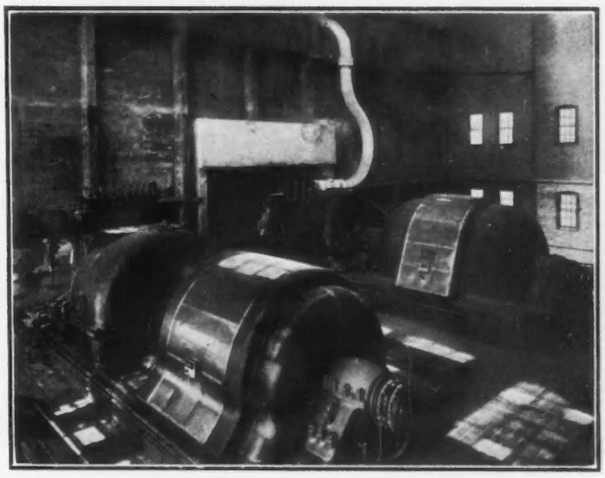


FIG. 3—7500-KW UNITS IN TURBINE ROOM OF WESTPORT STATION

This shell also contains a series of trays which receive the cooling water from the sprays. These trays are arranged to form cascades which will further condense the steam and prevent any steam entering the pipe leading to the air pumps. The air pipe is installed directly under the injection water pipe, and the water forms a curtain on either side further to prevent access of steam to the air outlet. The shell is of cast iron 1¼ in. thick, heavily ribbed to give the required strength. The steam inlet from the turbine is connected to this shell by means of a rectangular copper expansion joint. Two 24-in. flanges are also cast on

this shell, to which are connected two 24-in. multiplex atmospheric relief valves.

The shell is mounted on two cylindrical cast-iron pump casings. In each of these casings are mounted two 18-in. submerged-type centrifugal removal pumps. The impellers of these pumps are of brass and the shafts are of steel entirely brass-covered. A suitable Y-pipe is provided, connecting the discharges of each pair of pumps into one opening. Each pair of pumps has a discharge rating of 15,000 gal. per minute at high water, which is about 2 ft. below the basement-floor level.

Air removal is accomplished by means of two C. H. Wheeler-Thyssen centrifugal air-entrainment-type vacuum pumps. This is the first installation in this country of pumps of this size, although such pumps have been in operation in many of the larger power stations of Europe for several years. This pump is practically a double-impeller, single-stage, centrifugal pump with a horizontally divided case. The impellers discharge into an annular nozzle, from which the water emerges in a thin film of high velocity, entraining the air from the condensers and discharging the mixture against atmospheric pressure. In order that the impellers may retain their central position under the nozzle ring with varying positions of the adjustable ring, a small lateral movement of the nozzle ring is immediately followed by a movement of the shaft endwise, bringing the pump instantly into hydraulic balance.

The air pumps are directly connected by a flexible coupling to the removal pumps, which in turn are directly connected by a length of shaft to two 300-hp Terry turbines. Each turbine will consume under normal conditions 11,000 lb. of steam per hour, when supplied with steam at 175-lb. gage with 100 deg. of superheat. Each turbine is mounted on a base plate carrying an outboard bearing which holds one end of the short filler piece of shafting between the turbine and the removal pump.

The complete equipment was guaranteed by the manufacturer to condense 200,000 lb. of exhaust steam per hour and produce a vacuum of 1½ in. absolute when supplied with 25,000 gal. of cooling water per minute at a temperature not exceeding 70 deg. Fahr., the vacuum to be measured at a point within 12 in. of the exhaust inlet to the condenser.

The weight of the equipment is as follows: Condenser with removal pumps and casings, 110,000 lb.; two 300-hp Terry turbines, 15,000 lb.; two Thyssen air pumps, 15,000 lb.; water when outfit is in operation, 35,000 lb.

Turbo-Generator No. 6

The 7500-kw horizontal turbo-generator which replaced a 5000-kw vertical machine that was destroyed by accident is an eight-stage machine guaranteed to deliver 7500-kw, twenty-five-cycle, three-phase energy at 13,200 volts, 80 per cent power-factor, when running at 1500 r.p.m. The maximum temperature of the generator, as determined by thermometer, at 9375 kva and 80 per cent power-factor is guaranteed not to exceed 75 deg. C., provided that the temperature of air entering the generator does not exceed 25 deg. C. The armature was subjected to an insulation test of 30,000 volts. Excitation of 55 kw at 125 volts is required. The generator requires 25,000 cu. ft. of cooling air per minute, which is received through a duct from outside the building.

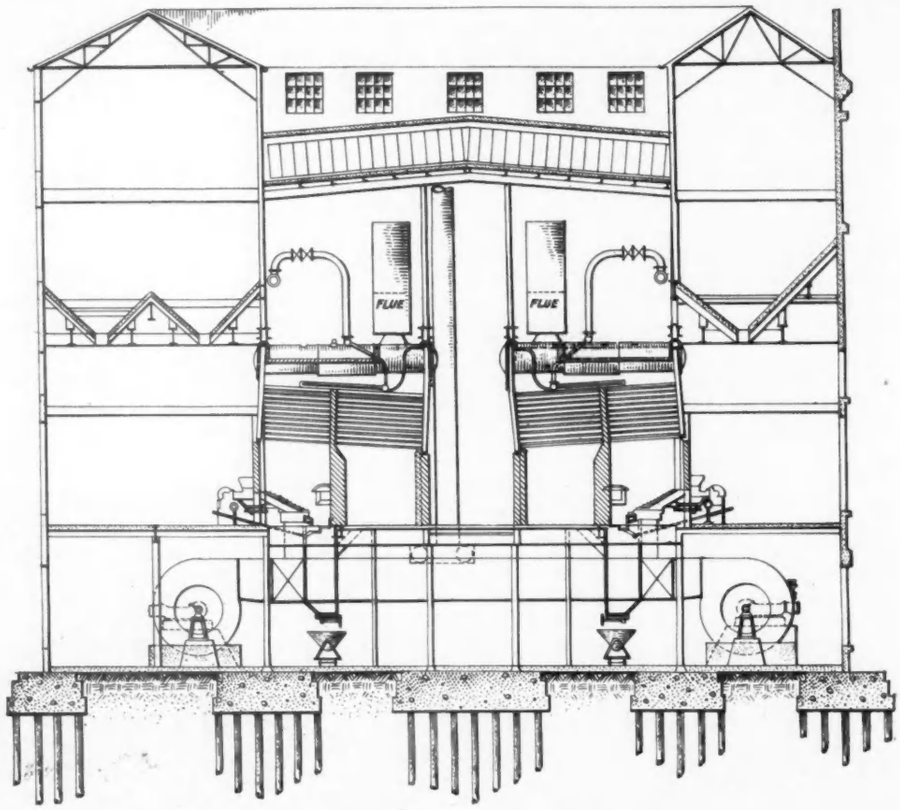


FIG. 4—CROSS-SECTION OF BOILER ROOM

With steam pressure at the throttle of 175 lb., superheat 100 deg., and an absolute back pressure in the exhaust chamber of the turbine of not more than 1½ in., the following steam consumption was guaranteed for the stated generator output: 3750 kw, 14.6 lb.; 6250 kw, 13.9 lb.; 7500 kw, 13.45 lb. These guarantees cover all leakages and losses in the turbine and generator, including the energy required for excitation and for supplying air for ventilation by means of the rotor fan. The variation in speed is guaranteed not to exceed 2 per cent for a change of one-half of the rated load.

This unit has the following approximate dimensions: Length over all, 31 ft. 6 in.; width over all, 12 ft. 7 in.; height, 12 ft. 9 in. The approximate net weight is 365,000 lb., and the generator armature, which is the heaviest piece, weighs 110,000 lb.

The machine was shipped on eight cars, and the total shipping weight was 395,350 lb. This was handled by a rigging company at 14 cents per 100 lb. from the cars to its final position, while the General Electric Company had charge of the erection, final adjustment, etc. From the time the first shipment was received it was only fifteen days until the machine was erected complete ready for steam. This unit had been erected and balanced at the shop and was ready for commercial service three days after steam was first admitted to the turbine.

The original vertical Curtis unit was served by two Alberger low-level jet condensers, one being placed on either side of the machine. The removal pump in each of these condensers is driven by a Fleming-Harrisburg horizontal engine. Air removal is accomplished by means of two direct-acting reciprocating air pumps made by the Alberger company. The condensers receive their injection water from the old intake tunnel which serves the engines in the old house and discharges into the tunnel already mentioned, immediately under the turbine-room basement. The openings into these two condensers were connected by means of three large castings, one of which had a flange arranged for direct connection to nozzle on the turbine as well as a 36-in. flange for connection to the atmospheric exhaust. Up to this time this arrangement seems to have worked perfectly.

Piping

In designing the piping for this addition an attempt was made to secure the utmost simplicity throughout and to have a minimum number of joints and valves in the entire system. All high-pressure superheated steam lines were made with welded nozzles and in lengths up to 34 ft. All valves for this system have cast-steel bodies with ground joints, with disks, seats and bushings of monel metal. All valves throughout have rising stems.

Each boiler is connected by an 8-in. line to a 15-in. ring header. In each of these lines is placed an 8-in. gate valve and an 8-in. non-return valve. The 15-in. ring header has additional openings at the end near the stack with blank flanges for future extension to the boilers, which will be placed on the other side of the stack. This ring header also has a blank flange in the line near the turbine room so that it can be connected directly with the second set of twelve boilers. In addition to this 15-in. main header an 18-in. header about 300 ft. long was run from what is known as the wing boiler house to provide steam for the 7500-kw unit and also to avoid any delay in starting the 15,000-kw unit if the new boiler room was not completed when this machine was ready to turn over. This precaution was well taken, as it was found impossible to put the new boilers on the line for more than a month after the machines were ready.

An 8-in. auxiliary steam header is placed just below the main boiler-room floor and is connected by two 8-in. lines to the 15-in. header above mentioned. This auxiliary header supplies steam to the three boiler-feed pumps through 2½-in. connections, to the four blower engines through 4-in. connections, and to the small turbines which drive the condenser pumps for the 15,000-kw condenser through a 6-in. line. Numerous drip connections have been provided on all headers, leading to two drip tanks which in turn are emptied by bucket traps. Schutte emergency valves are installed in the leads to all machines except the fan engines, it not being thought possible that these engines could run away, since they are directly connected to the fans.

A 36-in. main atmospheric exhaust line leads from each main unit to a point about 4 ft. above the roof of the boiler room. The exhaust steam from all auxiliary engines and turbines is carried to a 24-in. auxiliary exhaust main which lies just under the main boiler-room floor. This main is connected to a 24-in. uptake which carries the steam to the feed-water heaters.

A multiport relief valve is installed in this line, which will prevent excessive pressure in the heaters. Valves are so arranged that the steam can be conducted to either one or both of the heaters. Vents from the heaters are carried above the roof level.

The feed water is delivered to the heater pumps through a 12-in. lateral from the 16-in. line from the reservoir. These pumps deliver water directly to either or both of the heaters through a low-pressure feed-water line. A suction line also leads from this 12-in. main to one of the boiler-feed pumps, so that cold water may be pumped directly to the boilers in case of accident to the heaters or pumps. The heaters deliver water through a regulating valve to the V-notch meter box, which in turn is connected to the suction end of

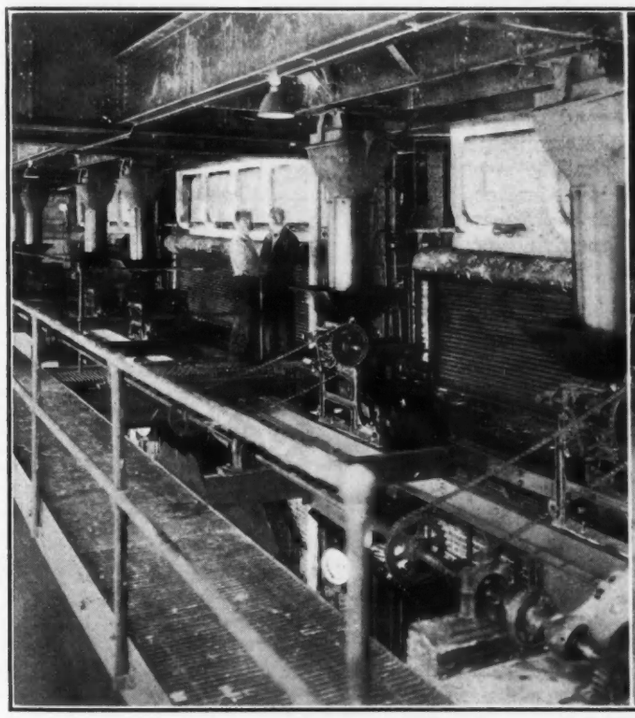


FIG. 5—COAL SCALES AND CHUTES

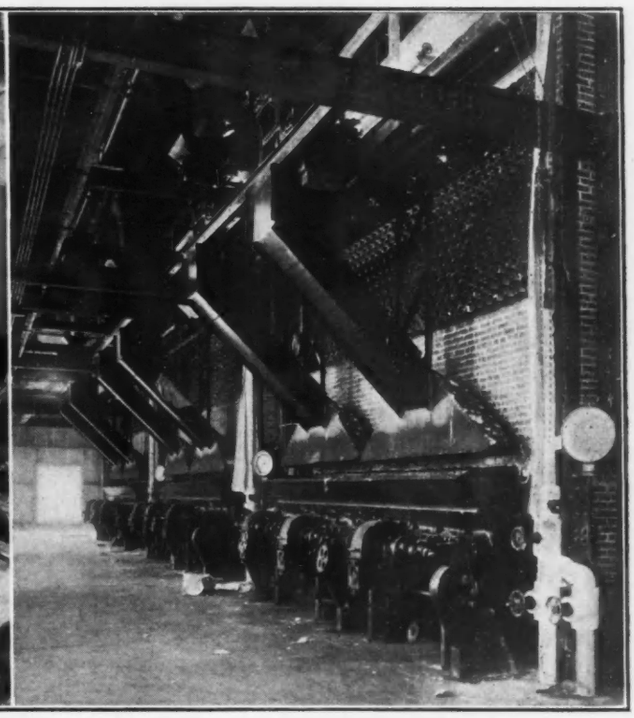


FIG. 6—FIRING AISLE OF NEW BOILER ROOM

the boiler-feed pumps by means of a low-pressure feed main. The hot water taken from this main is forced through a 10-in. high-pressure main connected to an 8-in. ring header, which later will be extended to six future boilers. An auxiliary 3-in. main was installed which can be used in case of emergency or to test any particular boiler while the others are in operation. Each boiler is connected to both lines by 3-in. brass pipe. A 4-in. fire line is also taken from the feed-water main.

Two 5-in. blow-off mains, each serving three boilers, have been installed just below the main boiler-room floor. The discharge ends of these lines are carried outside of the building and turn into the upper portion of a funnel which will carry the blow-off water directly to a 36-in. sewer, the discharge being visible to the operator.

The circulating-water piping is very simple, consisting of two 24-in. injection lines from the intake tunnel to the condenser shell of the 15,000-kw condenser. The 7500-kw machine was connected to the old condensers, and the old circulating-water piping was used.

The two service tanks on the roof of this building are connected to the service pumps by a 6-in. main. Numerous connections from this main are made for various purposes, such as plumbing, wetting down ashes, etc. The most important connection to this line is that to the oil-cooling coils on the turbines.

Boilers

The six boilers are of the three-pass type and were furnished and erected by the Edge Moor Iron Company, being supported upon the steel columns carrying the building structure. They are rated at 1047 hp, having a total heating surface of 10,470 sq. ft., and each boiler has 472 4-in. tubes 20 ft. long expanded into wrought-steel headers at front and rear. These tubes are arranged sixteen rows high and thirty wide. Wrought-steel hand-hole plates are placed opposite the end of each tube. The headers are connected to four steel drums 35⅛ in. in diameter and 20 ft. long, of 7/16-in. metal. The entire boiler is hung from the steel channel supports by four 3-in. round rods with ball joints.

Each of these boilers occupies a space 22 ft. 10 in. wide by 22 ft. 10½ in. long and 22 ft. 11⅜ in. high. The fire box is 19 ft. 6 in. wide to accommodate the stokers, while the general dimension inside to inside of wall is 19 ft. 2 in. The boilers are equipped with Foster superheaters arranged to heat 31,410 lb. of water to 487 deg. with a steam pressure of 200 lb. These superheaters are so designed that the drop in pressure through them shall not exceed 0.5 lb. at rated load, 2 lb. at 200 per cent of rating, and 4½ lb. at 300 per cent of rating. Both boilers and superheaters are guaranteed to give satisfactory service up to 300 per cent of rating if sufficient heat is provided from the furnace.

Stokers

The company has had four Taylor stokers in operation in the old boiler room with such satisfactory results that machines of the same make were purchased for this extension. These stokers are of unusual width owing to the size of the boilers, and each consists of eleven standard retorts. The width of the stoker is 19 ft. 6 in. and the depth 8 ft. 3½ in. They are provided with extension grates of the self-cleaning type.

The forced draft for these stokers is furnished by four American Blower Company's three-quarters-housed paddlewheel fans, directly connected to four Fleming-Harrisburg engines, which also furnish the power for driving the stokers. An independent drive for the stokers was considered, and provision has been made so that separate engines for this purpose can be installed at a later date if desired. Additional pulleys were also furnished on the fan shafts, so that a motor may be used if an engine should break down.

The following efficiencies were guaranteed by the contractor, provided the baffling in the boiler was so arranged that the temperature of the flue gas could not exceed 550 deg. Fahr. and that coal equivalent to or better than the following was used: Bituminous Coal —Moisture, 1.49 per cent; volatile matter, 20.48 per cent; fixed carbon, 69.47 per cent; ash, 8.56 per cent; sulphur, 1.57 per cent; pound-Fahrenheit heat units per pound as fired, 14,078.

When coal is burned at the rate of 4400 lb. per boiler per hour, the combined boiler and furnace efficiency shall be not less than 74 per cent. When the stokers are burning sufficient coal as specified, the combined boiler and furnace efficiency shall be not less than 72 per cent while developing 2000 hp and 68 per cent while developing 2500 hp. The contractor further guaranteed that the stoker shall be capable of developing 300 per cent normal boiler rating for a period of two hours, and 2500 hp continuously; also that the steam pressure shall be held within 5 lb. of the desired working pressure when the boilers are normally operated at not over 245 per cent of rating.

As it is often necessary in case of a severe storm to take on a heavy load in a short period of time, and since from the nature of this plant banked fires prevail a considerable portion of the time, the contractors were required to make the following further guarantees regarding rapidity of steaming:

"When maintaining a banked fire burning 320 lb. coal per boiler per hour, it will require three minutes to bring the boiler up to a steaming capacity equivalent to normal rating and nine minutes to a steaming capacity equivalent to 200 per cent of rating. With tight settings and thorough heat insulation it will require only 210 lb. coal per hour to maintain the banked condition. It is understood that in making tests to determine the above result the output of the boiler shall be measured by means of a steam-flow meter. It is understood that the company will furnish adequate draft apparatus for the removal of the gases without requiring positive pressure in the furnaces."

Feed-Water Heaters

Two 10,000-hp Cochrane feed-water heaters of the free-exhaust type are installed on what is known as the heater floor in the same bay as the stack and immediately over the boiler-feed pumps. Each of these heaters is equipped with a valved separator. Each heater occupies a floor space 8 ft. 9 in. by 8 ft. 9 in. and stands 8 ft. 3 in. above the floor, while the total weight empty is 25,000 lb. Each heater has a water space of 325 cu. ft. and a steam space of 187 cu. ft.

The general arrangement of the heaters, together with a Cochrane V-notch weir-measuring device and meter box, is shown on one of the accompanying drawings. The feed water from the heater pumps in the basement is delivered into a dividing box which is situated at such an elevation above the heaters that the water will pass by gravity to either or both as may be desired. With the number of boilers now installed one heater has ample heating power, but provision was made for the additional six boilers which will be installed in the future.

From the heaters the water passes by gravity to the V-notch meter box, the discharge being recorded by means of a Cochrane recorder placed just above the box. The flow of water to the dividing box and from the heaters to the meter is controlled by regulating valves in the line controlled by suitable floats which

rise and fall in unison with the water levels. The meter box weighs 21,000 lb. empty and 60,000 lb. when filled with water. This amount of water, with that in one of the heaters, gives a reserve of 64,000 lb. of hot water, or enough to run the six boilers at 200 per cent of rating for ten minutes.

Boiler-Feed Pumps

Three centrifugal boiler-feed pumping units are installed on the main floor of the boiler room in the aisle immediately below the stack. Each unit consists of a 5-in. three-stage Alberger turbine centrifugal pump mounted on a common base plate with, and directly connected by means of a flexible coupling to, a Curtis single-stage non-condensing steam turbine. The casing for both pump and turbine is split horizontally, the pump suction and discharge being on the lower half and the steam and exhaust openings on the turbine also on the lower half. The pump is fitted with bronze impellers, bronze diffusion rings and bronze protecting sleeves on the shaft.

With a head on the suction side not less than 10 ft., each unit is guaranteed by the makers to have a capacity of 500 gal. of 210-deg. water per minute, against a discharge pressure of 240 lb. per sq. in. when operating at a speed of approximately 2500 r.p.m., supplied with steam at an effective gage pressure of 175 lb. and 100 deg. of superheat at the turbine throttle, and exhausting against atmospheric pressure. Under the above conditions a pump efficiency of 65 per cent and a maximum steam consumption not to exceed 34.2 lb. per brake-hp is guaranteed. The maximum head at no delivery will be 600 ft., equivalent to 260 lb. pressure. These pumps will also lift cold water through a total suction lift of 20 ft. The performance of the combined unit at other capacities is given in the accompanying table:

DATA ON PERFORMANCE OF COMBINED UNIT

Gallons per Minute	Total Head, Ft.	R.p.m.	Pump Efficiency, per Cent	Brake-hp	Steam per Brake-hp Lb.
500	555	2500	65	108	34.2
375	555	2360	62	85	36.0
250	555	2240	54	65.2	42.5

Heater Pumps

Water is supplied to the heaters from the main supply pipe connected with the reservoir by means of two pumps installed in the boiler-room basement almost directly below the heaters. Each unit consists of one 8-in. Alberger horizontal turbo volute centrifugal pump on a common base with and directly connected to a 20-hp Westinghouse induction motor. These pumps have horizontally split casings and are provided with bronze impellers, and the shaft is bronze-covered where it comes in contact with the water. They are guaranteed by the maker to deliver 1000 gal. each against a total dynamic head of 50 ft. when running at a speed of 1440 r.p.m., with a pump efficiency of 65 per cent. requiring approximately 19.4 brake-hp.

Service Pumps

Two smaller pumps are also provided in the basement which supply water for general service use around the building and which discharge into the service tanks on the roof of the boiler house.

Each unit consists of a 2½-in. Alberger single-suction volute centrifugal pump on a common base with and directly connected to a 7.5-hp Westinghouse induction motor. These pumps also have bronze impellers and bronze protecting sleeves on the steel shaft. They are guaranteed by the maker to deliver 150 gal. per minute against a total dynamic head of 90 ft. when operating at a speed of 1440 r.p.m. with a pump efficiency of 55 per cent, requiring approximately 6.3 brake-hp at the pump shaft.

Recording and Regulating Instruments

A full equipment of recording apparatus for the new boiler room was installed consisting of a steam-flow meter of the recording type and two Richardson automatic coal scales for each boiler, as well as a complete equipment of recording thermometers, gages, etc. This includes thermometers for steam, service water, flue gas, and for the incoming and outgoing circulating water of both machines. A recording vacuum gage is provided for each condenser, and an absolute pressure gage has been installed in connection with each of these vacuum gages for testing purposes.

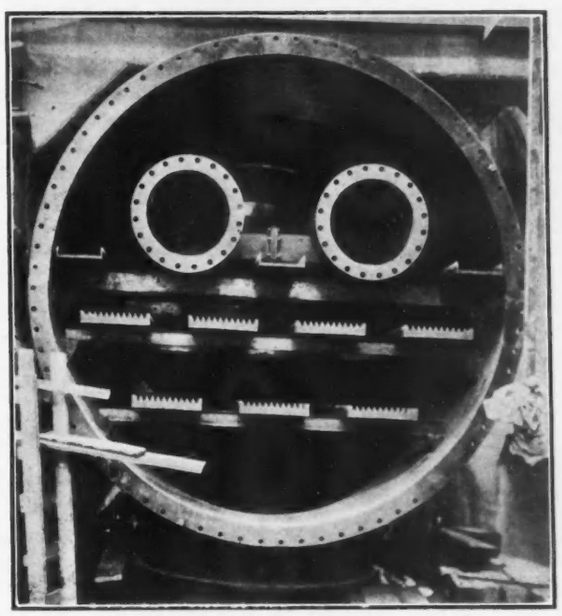


FIG. 7—END OF THE SHELL OF 15,000-KW UNIT

The draft on the boilers is controlled by Blaisdell-Canady regulators. A single CO_2 recorder was installed for testing purposes and for adjusting and determining the most efficient method of handling each boiler.

Coal Handling

Coal is delivered to the new boiler house by the following method: The gantry crane which served the old boiler house delivers coal in the end coal pocket of this house. A chute from this coal pocket delivers coal to a skip hoist, which in turn elevates coal to a hopper some distance above the roof. The coal is taken from this hopper into an electric car which transfers it to a hopper over the other boiler room. From this hopper it is dumped into a cable or hand car which passes over the new coal bunkers. A complete new coal-handling system, consisting of a rapid hoist tower and a bridge leading to the track over the new boiler house, is in contemplation. The apparatus above mentioned will then be arranged so that the coal can be transferred in case of emergency from one system to the other.

Ash Handling

Ashes from the automatic stokers are delivered into ash hoppers immediately below the boiler. Perforated

pipes have been arranged in each of these ash hoppers so that the ashes may be cooled while they are being dumped. These ash hoppers are built of expanded metal and concrete and are lined on the inside with firebrick. From these hoppers the ashes are dumped into side dumping cars and pushed by hand over an industrial railway to a point outside of the station, where they are used for filling and making additional ground on the company's property.

Patapsco Pipe Line and Pumping Station

The boiler-feed water supply for the old boiler house was received directly from a reservoir which was filled from a small stream about 1 mile from the station. This stream was badly polluted, and it was found necessary to filter the water. Also, as this was a very small stream and the capacity of the existing 8-in. pipe line was small, a new pumping station was built on the Patapsco River about 3 miles from the Westport power house, where exceptionally good boiler-feed water was secured. This pumping station delivers water through a 16-in. main to the reservoir. A by-pass connection has been made to the filter house so that the water may be filtered when necessary.

The general contractors on this work were Messrs. Morrow Brothers, of Baltimore. The contractors for the equipment have been mentioned in the body of the article. Mr. E. D. Edmonston is general superintendent for the Consolidated Gas, Electric Light & Power Company and has general charge of the operation and construction of this station. Mr. A. S. Loizeaux is electrical engineer for the company, while the writer had direct charge of the designs, construction and installation of the equipment.

Applications of Concentrated-Filament Lamps

The field of application for concentrated-filament lamps covers an extensive variety of uses. In it are included all sorts of headlamp service on land, sea and in the air, in railroad signals, range lighting of waterways, heliograph signals, small moving-picture outfits and stereopticons. Several thousand 6-volt headlamps are now in railroad service. These are of 108 watts rating, 150 cp, and in a 20-in. silver-plated parabolic reflector produced nearly 1,000,000 beam cp. Objects 2000 ft. distant easily can be identified. The simplicity and steadiness of the concentrated-filament lamp are great advantages. Railroad signal lamps of this type are now under test, and it is claimed that they can be read more easily against the setting sun than is the case with semaphores.

The chief commercial demand for concentrated-filament lamps will come from the stereopticon field and other applications where 105-volt to 125-volt energy is available. The operation of projector lanterns is greatly simplified, noise is eliminated, and the 100-watt and 250-watt lamps used in lighter and larger service are interchangeable. The needs of the larger lanterns are met by the 500-watt and 1000-watt concentrated-filament, gas-filled lamps. These should always be used with a spherical mirror, thereby increasing the intensity on the screen at least 30 per cent and also giving a more uniform field. No satisfactory lamp has yet been developed for the larger moving-picture machines, but lamps of very high candle-power are being tested, and it is hoped that these when used with proper mirrors and condensing lenses will be successful. Their adaptation to moving-picture machines would largely reduce the fire risk and eliminate synchronism difficulties in theaters on alternating-current service.

Calculation of the Performance of an Induction Motor—I

BY WALDO V. LYON

The following method of calculating the performance of an induction motor or of an induction generator has been based upon the regular equivalent circuit diagram (or transformer diagram), and while it is practically as accurate, the computation is much simplified. This simplification results from dividing the leakage impedance drop in the stator winding into two components, viz., the drop due to the no-load component of the stator current and that due to the load component. The transformer diagram embodying this construction is given in Fig. 1. All rotor constants and quantities are reduced to their equivalent single-phase values on the stator side. While this method does not give the accuracy that a more complete analysis would produce, it answers the needs of commercial testing sufficiently well in the majority of cases.

In Fig. 1, which is drawn for the equivalent single-phase motor:

I_2 = rotor current,
I_n = total no-load current ($= \sqrt{3}$ times no-load line current for a three-phase motor),
I_1 = stator current ($= \sqrt{3}$ times line current for a three-phase motor),
$I_1' = -I_2$ = load component of stator current,
V_1 = stator impressed voltage (between terminals),
φ = resultant air-gap flux,
E_2 = emf generated in stator and rotor winding by the resultant air-gap flux.

Working Formulas

Induction Motor.—For the purpose of calculation it is simpler to reduce the actual constants of the motor to their equivalent single-phase values. In all that follows this will be done. These constants are computed from test data, as will be presently shown by example, and are:

r_1 = stator effective resistance,
r_2 = rotor ohmic resistance,
x_1 = stator leakage reactance at normal frequency,
x_2 = rotor leakage reactance at normal frequency,
I_n = no-load stator current,
$\cos\theta_n$ = no-load power-factor,
P_r = no-load rotation and core losses.

From the above constants an auxiliary set of constants are computed as follows:

$$\sin\theta_n = 1 - \frac{\cos^2\theta_n}{2} \text{ (or from tables)},$$
$$R = r_1 + r_2,$$
$$X = x_1 + x_2,$$
$$b = \frac{1}{2}X^2,$$
$$E_1 = V_1 - x_1 I_n \quad (V_1 = \text{line voltage}),$$
$$c = \frac{I_n}{E_1},$$
$$d = (cx_2 + \sin\theta_n)^2.$$

In order to calculate the performance of the motor at some particular output, P_o, it is first necessary to estimate the slip. This can be done very closely as follows:

Let

$$y = \left(\frac{E_1^2}{P_o} - 2R\right) - \frac{Z^2}{\left(\frac{E_1^2}{P_o} - 2R\right)}, \qquad (1)^*$$

where Z is the short-circuit impedance of the motor. The slip is then

*The derivation of these formulas will be given in the second part of this article.

$$s = \frac{r_2}{y + r_2}. \qquad (2)$$

Having found the slip for, say, full load, it is convenient to calculate the performance curves at different fractions of the full-load slip rather than at different fractions of full load. The latter can be readily done, however, by applying formulas (1) and (2).

The rotor current is

$$I_2 = \frac{E_1}{\left(\frac{r_2}{s} + r_1\right) + \frac{b}{\left(\frac{r_2}{s} + r_1\right)}}. \qquad (3)$$

The stator current is

$$I_1 = I_2 \sqrt{\left(c\,\frac{r_2}{s} + \cos\theta_n\right)^2 + d}. \qquad (4)$$

The copper and stray losses in the stator are $r_1 I_1^2$.

The power transferred across the air-gap is

$$P_2 = \frac{r_2}{s} I_2^2. \qquad (5)$$

The power output is $P_o = P_2(1 - s)$. (6)

The torque in pound-feet is

$$T = \left(\frac{550}{746}\,\frac{p}{4\pi f}\right) P_2, \qquad (7)$$

where p = number of poles and f = frequency.

The power input is $P_i = P_2 + r_1 I_1^2 + P_r$. (8)

The power-factor is

$$PF = \frac{P_i}{V_1 I_1}. \qquad (9)$$

The efficiency is

$$\eta = \frac{P_o}{P_i}. \qquad (10)$$

Some of these formulas and those that immediately follow are subject to small corrections which are usually

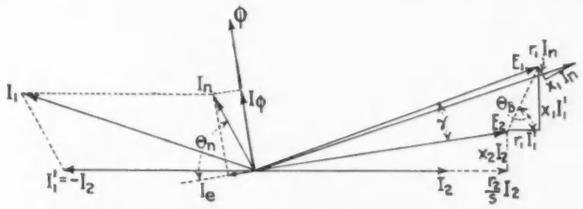


FIG. 1—CURRENT, FLUX AND VOLTAGE DIAGRAM

of negligible effect but which it may be desirable to apply in some cases. These corrections will be explained under "Derivation of Formulas."

Induction Generator.—The performance as an induction generator can be obtained just as readily. The slip for a given electrical output, P_o, is found as follows:

Let

$$u = \frac{E_1^2}{P_o + P_n} - \frac{Z^2}{\frac{E_1^2}{P_o + P_n}}. \qquad (11)$$

As before, Z is the short-circuit impedance of the motor, and P_n is the no-load input when running as a motor.

The slip is then

$$s = \frac{r_2}{u + r_1}. \qquad (12)$$

The rotor current is

$$I_2 = \frac{E_1}{\left(\frac{r_2}{s} - r_1\right) + \frac{b}{\left(\frac{r_2}{s} - r_1\right)}}. \qquad (13)$$

The stator current is

$$I_1 = I_2 \sqrt{\left(c\,\frac{r_2}{s} - \cos\theta_n\right)^2 + d}. \qquad (14)$$

The input is

$$P_i = \frac{r_2}{s} I_2^2 (1 + s). \qquad (15)$$

The output is

$$P_o = \frac{r_2}{s} I_2^2 - r_1 I_1^2 - P_r. \qquad (16)$$

The power-factor is

$$PF = \frac{P_o}{V_1 I_1}. \qquad (17)$$

The efficiency is

$$\eta = \frac{P_o}{P_i}. \qquad (18)$$

Numerical Example

As an illustration of the application of the above formulas, the following numerical example is given:

Full-load output, 1950 kw.

Voltage between terminals, 6400 volts.

Frequency, twenty-five cycles per second.

Number of phases, three.

Number of poles, thirty-six.

Temperature on continuous load, 71 deg. C.

Ohmic resistance between terminals at 25 deg. C., stator, 0.561 ohm; rotor, 0.0766 ohm.

Ratio of transformation, 6400/2076.

No-load test, temperature, 25 deg. C.: Line voltage, 6400 volts; line current, 89.5 amp; power input, 47,500 watts.

Blocked test, temperature, 25 deg. C.: Line voltage, 2200 volts; line current, 369 amp; power input, 375,000 watts.

Assume that the ratio of the effective to the ohmic resistance for the blocked test is 20 per cent greater for the rotor than for the stator, and that, at the rated frequency at 25 deg. C., the ratio of the stator leakage reactance to the rotor leakage reactance is the same as the ratio of the stator ohmic resistance to the rotor ohmic resistance. The proper assumptions to make in regard to these ratios are a matter of experience. The better the assumptions, the more exact will be the calculations. The accuracy of the calculated performance depends primarily upon the value of the rotor resistance, and its determination should be as exact as possible. The assumptions made regarding the other constants are of much less importance. The resistance of a wound rotor may be measured by direct current before the winding is short-circuited, as is done in the present example. Otherwise it may be difficult to obtain an exact value of the rotor resistance.

Determination of r_2.—For a three-phase motor the equivalent single-phase resistance of the winding is one-half of the resistance measured between terminals. The equivalent single-phase resistances of the stator and rotor windings are respectively 0.281 ohm and 0.0383 ohm at 25 deg. C. The resistance of the rotor winding referred to the stator is its actual resistance multiplied by the square of the ratio of transformation. In this case it is $0.0383 \times (6400/2076)^2 = 0.364$ ohm at 25 deg. C. At the running temperature of 71 deg. C. the rotor resistance is therefore

$$r_2 = 0.364\left(1 + \frac{71 - 25}{234.5 + 25}\right) = 0.429 \text{ ohm}.$$

Determination of r_1.—The effective resistance of the stator winding is not so easily found. The combined effective resistance at normal frequency of the stator and rotor windings at 25 deg. C. is found from the short-circuit data to be $375{,}000/(\sqrt{3} \times 369)^2 = 0.917$, remembering that the equivalent single-phase current is $\sqrt{3}$ times the line current in the case of a three-phase winding.

Let k represent the ratio of the effective to the ohmic

resistance of the stator winding at 25 deg. C. Then $1.2k$ is the corresponding ratio for the rotor winding at this temperature. Then $k \times 0.281 + 1.2k \times 0.364 = 0.917$, from which $k = 1.28$. The effective resistance of the stator winding at 25 deg. C. is then $1.28 \times 0.281 = 0.359$ ohm. The part of this resistance which is due to the stray losses is $0.359 - 0.281 = 0.078$ ohm. This is assumed to be constant and independent of the temperature. The ohmic resistance of the stator winding at 71 deg. C. is

$$0.281\left(1 + \frac{71 - 25}{234.5 + 25}\right) = 0.331.$$

The effective resistance of the stator winding at 71 deg. C. is therefore

$$r_1 = 0.331 + 0.078 = 0.409 \text{ ohm.}$$

Determination of x_1 and x_2.—The combined leakage reactance of the stator and rotor winding is found from the short-circuit data, which give for the combined impedance

$$Z = 2200/(\sqrt{3} \times 369) = 3.44 \text{ ohms.}$$

$\cos \theta_n = 0.0479$, $\sin \theta_n = 0.999$,
$r_1 = 0.409$, $R = 0.838$,
$r_2 = 0.429$, $X = 3.32$,
$x_1 = 1.45$, $b = 5.52$,
$x_2 = 1.87$, $E_1 = 6175$,
$Z = 3.44$,
$I_n = 155$, $c = 0.0251$,
$P_r = 38{,}900$, $d = 1.094$.

Calculation of Performance.—The following table gives the calculated performance of the motor at full load and at one-quarter, one-half, three-quarters and one and one-quarter of full-load slip. In the last line of this table is given the calculated performance when the motor is operated as an induction generator at an output of 2000 kw at 6400 volts.

The full-load slip (as a motor) is found by equations (1) and (2), viz.,

$$y = \left(\frac{6175^2}{1{,}950{,}000} - 1.68\right) - \frac{3.44^2}{\left(\frac{6175^2}{1{,}950{,}000} - 1.68\right)} = 17.24.$$

PERFORMANCE OF INDUCTION MOTOR

Slip (s)			Rotor Current (I_2)		Stator Current (I_1)		Power Across Air-Gap (P_2)	Kw Output (P_0)	Torque T (lb-ft.)	Kw Input (P_i)	Power-Factor	Efficiency (η)
Equation	$\frac{r_2}{s}$	$r_1 + \frac{r}{s}$	(3)	$(c\frac{r_2}{s} + \cos\theta_n)^2$	(4)	$r_1 I_1^2$ (kw)	(5)	(6)	(7)	(8)	(9)	(10)
0.00607	70.7	71.1	86.8	3.29	181.8	13.53	533	529.6	45,000	585	0.503	0.906
0.0122	35.2	35.6	172.7	0.867	241.9	23.93	1050	1037	88,700	1113	0.719	0.932
0.0183	23.45	23.86	256.4	0.406	314.0	40.4	1543	1515	130,300	1622	0.807	0.934
0.0243	17.67	18.08	336.0	0.252	389.8	62.2	1996	1947	168,600	2097	0.841	0.929
0.0304	14.11	14.52	414.6	0.170	466.0	88.9	2427	2353	205,000	2555	0.857	0.921

PERFORMANCE OF INDUCTION GENERATOR

Equation	$\frac{r_2}{s}$	$\frac{r_2}{s} - r_1$	(13)	$(c\frac{r_2}{s} - \cos\theta_n)^2$	(14)	$r_1 I_1^2$ (kw)	$\frac{r_2}{s} I_2^2$ (kw)	(16)		(15)	(17)	(18)
0.0233	18.42	18.01	337.0	0.414	378.5	58.5	2094	1997		2144	0.825	0.931

The combined reactance is

$$X = \sqrt{3.44^2 - 0.917^2} = 3.32 \text{ ohms.}$$

From the assumption regarding the relation between the ohmic resistances and the leakage reactances,

$$\frac{x_1}{x_2} = \frac{0.281}{0.364},$$

which gives $x_1 = 1.45$ ohms,
$x_2 = 1.87$ ohms.

Determination of I_n, θ_n and P_r.—The equivalent single-phase value of the no-load current is

$$I_n = \sqrt{3} \times 89.5 = 155 \text{ amp.}$$

The no-load power-factor is

$$\cos \theta_n = \frac{47{,}500}{6400 \times 155} = 0.0479.$$

The no-load rotation and core losses equal the no-load power less the stator copper and stray losses. At 25 deg. C. these losses are $0.359 \times 155^2 = 8640$ watts. The rotation and core losses are therefore

$$P_r = 47{,}500 - 8640 = 38{,}900 \text{ watts.}$$

These losses vary with the load, but the variation is not large and no account of it will be taken.

Determination of Auxiliary Constants.—The auxiliary constants may now be computed. They are given in the right-hand column in the following tabulation. At the left is a summary of the fundamental constants.

$$s = \frac{0.429}{17.24 + 0.429} = 0.0243.$$

The slip when this motor is operated as an induction generator with an output of 2000 kw at 6400 volts, as found by equations (11) and (12), is given in the accompanying table. This tabulated performance is not corrected for the effect of friction and windage. For this particular motor the friction and windage loss was not known. Observe that the calculated output at full load is but 0.15 per cent lower than the rated full load. This shows how close an approximation is obtained in equations (1) and (2). Similarly, in the case of the induction generator, the output calculated from the slip is only 0.15 per cent lower than the assumed output of 2000 kw, which shows the degree of accuracy of equations (11) and (12).

Time Required for Calculations.—It is of interest to know the length of time required to make the computations here given. A 20-in. slide rule was used and the work was done steadily but without hurrying. Twenty minutes were required to compute the table of constants from the data, and forty minutes were required to calculate the five points of the tabulated performance, or about eight minutes to a point. It required about twenty minutes to calculate the performance as an induction generator.

Part II of this article, dealing with the derivation of formulas, will appear in a later issue of the ELECTRICAL WORLD.

Municipal Operation in Pasadena, Cal.

Analysis and Review of Annual Reports by Los Angeles Experts, Together with Reply of Superintendent Koiner

A COPY of the annual report for the year ended June 30, 1914, of Mr. C. W. Koiner, general manager of the municipal lighting works department of the city of Pasadena, Cal., has been received. An analysis and review of the report by Mr. R. H. Ballard, consulting engineer, of Los Angeles, Cal., has also been received. An abstract of the report and the analysis by Mr. Ballard were sent by the ELECTRICAL WORLD to Mr. Koiner, who answered the criticisms. This article presents the various statements.

Report of Mr. Koiner

Depreciation has been charged from the time the plant was started. The book reserve is $130,871, which has been invested in property used in the department. The amount set aside to cover depreciation or deferred maintenance last year was $27,408. The direct debt was $327,000, although the cost to date is $697,505. The department is not required to pay interest on the total average investment, but only interest on outstanding bonds, which amounted to $11,551 last year. On money received above that obtained from bond issues no interest has to be paid. The method of charging all costs in connection with the department comprehends an interest charge on the total average investment. After allowing for interest on the total average investment and for depreciation, a surplus remains of $29,361. The total balance sheet surplus is $71,110, which is invested in extensions and working capital. The saving from Oct. 1, 1908, to June 30, 1913, by reason of the difference in rates charged before the city entered the business and rates in neighboring cities since the city began is $731,084.

Certain intangible values have not been added to the statement of property cost. Engineering and supervision were charged to operating expense. The cost of building up the business, advertising and soliciting in competition with a strong competitor has been charged to operating expense. Reductions in rates have been made from a maximum of 12½ cents per kw-hr., less 10 per cent for prompt payment, to a maximum of 5 cents per kw-hr. for energy for lighting. Until Sept. 23, 1913, the competitor of the department made a maximum base rate of 4 cents per kw-hr. At that time the company, complying with the unjust competition act of the Legislature, had either to lower its rates in other communities to the Pasadena scale or to raise its rates in Pasadena to those charged by the department. The company chose the latter. The average rate received for street lighting for the year, including incandescent lamps, arc lamps and ornamental systems, was 4.681 cents per kw-hr., as compared with 4.954 cents per kw-hr. for commercial service.

The report shows: Receipts, $176,431; operating expenses, $96,642; interest, $23,021; depreciation, $27,408; surplus, $29,360.

Analysis of Mr. Ballard

The total investment is reported as $697,505. The balance sheet shows that $278,986 is the net balance received from bond sales; $209,252 was contributed to the department from taxes and the balance was raised by (1) the use of funds which properly should have been set aside from earnings for depreciation, and (2) alleged earnings for seven years. Taxpayers authorized the expenditure of funds from bond sales but not the remaining $418,519 expenditures. The Pasadena lighting department is not required to pay interest on bonds because this is paid out of the general fund, and thus met by taxpayers. No reduction in street-lighting rates has been made in seven years, and therefore net earnings from this service are naturally very large. The net return from this source for the year was 16.02 per cent on the capital investment in this part of the business.

The report gives sufficient data to permit a division between street lighting and commercial service. The average rate for street lighting was 4.68 cents per kw-hr. and for commercial service 3.46 cents per kw-hr. Using the totals as reported, the division between street lighting and commercial service is as shown in the accompanying table.

SEGREGATION OF STREET LIGHTING AND COMMERCIAL SERVICE MADE BY MR. BALLARD

	Street Lighting	Commercial	Total
Gross revenue	$48,573	$127,858	$176,431
Operating expenses:			
Manufacturing: Divided on basis of peak load for constant charges and kilowatt-hours output for variable charges	$9,770	$34,673	$44,443
Distribution: Divided on basis of character of individual accounts	6,580	23,748	30,328
General: All but incidental supervision applying to commercial light and power	1,200	20,671	21,871
Total operating expenses	$17,550	$79,092	$96,642
Balance	$31,023	$48,766	$79,789
Total property investment: Generating plant divided on basis of peak load, all other divided according to character of investment	$193,701	$503,803	$697,505
Rate of return on property investment for interest and depreciation —per cent	16.02	9.68	11.44
Interest and depreciation: Divided in proportion to property investment	$14,019	$36,409	$50,428
Surplus earnings	$17,004	$12,357	$29,361
Deductions from surplus (commercial) which Mr. Ballard claimed should be made	.....	50,240	.....
Deficit on commercial business resulting from the calculation of Mr. Ballard	.....	$37,883	.....

This analysis makes it evident that the municipal department is charging for street lighting $17,004 more than cost, such cost including interest and depreciation on investment as shown by the report. The report shows surplus earnings, including both street lighting and commercial service, of $29,361. Deduction of the overcharge on street-lighting account, $17,004, leaves a balance of $12,357. Examination shows that a number of items properly chargeable in operating expense have been omitted, as follows:

Provision for injuries and damages, notwithstanding $9,000 paid in the previous year on this account; for this $5,000 should be provided annually. Cost of con-

nections is not included; there were 669 disconnections in the year, costing approximately $5,000. Rent of office is stated as $165, while the lighting department occupies separate quarters provided by the city by an expenditure of $25,000 from other funds; this should be increased $735. Insurance is reported at $150; proper insurance would cost an additional $1,500. Legal expenses are not included, although a large part of the time of the city legal department is used; a reasonable charge would be $1,500. On the assumption that the plant is not required to pay taxes this is not included; under private ownership taxpayers would be relieved of 4.6 per cent of the gross earnings of all business done by the municipal plant, which would amount to $8,116. The municipal plant does not pay city fees for permits and inspections, while the private company is charged 75 cents per meter; the municipal department should be charged the same because the city would have received the money if these connections had been made by the private company, amounting to $1,947. Depreciation is charged at less than 4 per cent on cost of property; it should be at least 6 per cent, increasing the charge $14,442. The expenditure for repairs was $9,434, or 1.33 per cent on cost of property, and nothing was included for maintenance; complete repair and 100 per cent efficiency would require approximately $12,000 additional. The foregoing deductionse from surplus, $50,240, taken from the $12,357 surplus remaining after correction of the street-lighting charge, would indicate a deficit on commercial business of $37,883.

Many omissions in operating expense are due unquestionably to the imperfect accounting system. Starting with July 1, 1914, however, the municipal department adopted the system prescribed by the Railroad Commission of California, and this should tend to correct some errors. While the operating ratio, according to the report, was 54.77 per cent, the report for July, 1914, compiled under the Railroad Commission system, increased the ratio to 61.81 per cent.

The claim of saving to consumers is based on the untenable assumption that but for the existence of this plant the rates would now be as they were in 1908. It does not admit the influence of progress in the art. The city plant's average rate now is 3.724 cents per kw-hr.; the Southern California Edison Company's for all its territory, including Pasadena, is 2.06. Had the city plant sold its 4,737,271 kw-hr. at an average rate as low as the Edison company's, it would have shown a deficit of about $77,000, approximately three times the total profit claimed.

Mr. Koiner's Reply

"Mr. Ballard states that the taxpayers did not authorize the expenditure of $418,519. These expenditures have been made under the supervision and authorization of the Councilmen and Commissioners of the city since the plant began operation. These gentlemen are authorized by the charter to conduct the business of this city.

"In replying to the statement that no reduction in street-lighting rates has been made in seven years, I refer to page 8 of the report. The department is supplying 80-cp lamps in place of the 40-cp street series lamps for the same price, namely $1 per month, or $12 per year, for 80-cp lamps. The rate charged for arc lighting is $5 per month for 6.6 amp; for 600-cp street series lamps, $5 per month; for ornamental lighting in the residence section, 3½ cents per kw-hr.; for ornamental lighting in the business section, 3 cents per kw-hr.; on one stretch of street where we have a rental for underground conduits a charge of 4.3 cents per kw-hr. has been made. These rates are no higher than, and not as high in many cases as, neighboring cities pay our competitor.

"Mr. Ballard did not include enough in his division of expenses for generation and general expense. (I am sure he would charge more than $1,200 to cover general expense pertaining to street lighting in any city the size of Pasadena.)

"Mr. Ballard refers to the average rate of 4.68 cents per kw-hr. for street lighting and compares it with the average rate for commercial service, including energy sold for motor service, 3.46 cents per kw-hr. Let us be fair and deduct energy sold for commercial service and make the comparison on the proper basis, which would give the correct figure, 4.954 cents per kw-hr., for all energy for commercial lighting. This shows that we received a higher average rate for all illumination other than street lighting, while we received the low average rate of 1.942 cents per kw-hr. for all energy for motor service. This should not be used in comparison to lower the average.

"We all have to acknowledge that street-lighting equipment depreciates and becomes obsolete much more rapidly than some of the other equipment used for commercial lighting. Street-lighting fixtures change so fast that it is difficult to keep up with them. All this has to be written off, and I will say that, owing to changes in fixtures and systems, this department has some heavy depreciation charges to be made against street-lighting equipment. As an illustration, we have installed 12 miles to 14 miles of ornamental street lighting, with many more miles to be installed, replacing street-lighting equipment which has been in use only a few years. All labor formerly charged to capital in the erection of this work, as well as obsolete fixtures, etc., will have to be charged to depreciation. Therefore depreciation for the next few years on our street-lighting equipment is going to be heavier, and we propose to charge off considerable obsolete equipment.

"Every expense pertaining to injuries and damages for the year was included in 'emergencies,' $2,174. One damage claim of $9,000 was paid directly from surplus. All injuries and damages to date have been charged directly to operating expense. We prefer to carry our own insurance, and if we should have an exceedingly heavy damage account for one year we would take it from surplus. That is why we charge a rate that will give us a surplus fund for unforeseen emergencies or extraordinary expenses, etc.

"The operating expense, 'operating expenses pertaining to commercial light and power,' which amounted to $14,511 for the year, carried all costs of disconnections, temporary connections, etc. The disconnections did not cost $5,000.

"Rent of office: I admit that $165 for the year was less than the department should have paid. The $25,000 property referred to is occupied jointly by the water and light departments. We are paying rent this year to cover the proper amount charged against this department for quarters. Formerly we paid $75 per month for the lower floor of the building.

"Insurance: The department carries its own insurance, except boiler insurance, as we have found that it pays.

"Legal expenses: The previous year we had legal expenses of $508. This year we had none. I agree that we should pay for legal expense that belongs properly to our department or any expense incurred by reason of our department.

"Taxes: It is true that the city plant does not have to pay taxes. However, the taxes that would be levied can be taken out of surplus each year, if desired.

"Fees: The municipal plant stands in a different relation from that of a private corporation. Municipal

employees would not be retained if they did not obey all rules set for others. The fee is charged for inspection to show that the private company performs its work properly. The commission does not have direct charge of employees of the company, and it is through this city inspection system that the company installations are kept safe. These charges would not be very much, and they could be added to the amount charged for taxes and deducted from the surplus, which is ample to take care of such charges as any critic might wish to see levied.

"Depreciation: Our depreciation account in our report, page 20, shows that we have depreciated our property according to its life (the authority for the schedule used is shown on page 24), and the depreciation on the items ranges from 2 per cent to 20 per cent. Our expenditures for repairs included all maintenance. Most of the item was for maintenance and some reconstruction which properly could have been charged to capital account. The cost of engineering and supervision of all construction work has been charged to operating expenses.

"Mr. Ballard's statement concerning a deficit which he has set up on commercial business is so arbitrary, unreasonable and incorrect, in view of all the figures and facts, that I must leave it to intelligent readers to satisfy themselves whether his allegations are correct or incorrect.

"All expenses which should be included in operation have been included; all proper charges for depreciation have been included. Much garage equipment has been charged direct to operation, and also much office equipment, typewriters, etc.

"Mr. Ballard refers to many omissions in operating expenses as due to an imperfect accounting system. The classification of accounts is on page 25 of the report, and I submit this to those interested. This is a modified form used throughout the country and formerly used for a number of central stations in charge of the writer.

"Mr. Ballard picked out the report for July, 1914, the first month we have followed the Railroad Commission classification, and he points to the operating ratio of 61.81 per cent, while the ratio for the twelve months, taking the fat months with the lean, was 54.77 per cent. Mr. Ballard, I am sure, will be fair and concede me the privilege of referring to January, 1915, one of the fat months, in which the ratio was 40.81 per cent. The average for the six months ended Dec. 31, 1914, was 54.83 per cent, while our report for July, 1913, shows 59.77 per cent.

"One very important point has been overlooked by Mr. Ballard. That is the saving effected from the time the plant was started to June 30, 1914, by the difference in rates charged before the city entered the business and the rates charged neighboring cities since, which amounts to approximately $731,084, as referred to on page 5 of the report. This money is kept in the pockets of consumers, and the sum saved is equal to the value of the plant. I have not calculated this saving on the basis that the rate of 12½ cents per kw-hr. would have prevailed up to the present, but have assumed that Pasadena would have had as good a rate as is charged by our competitor in neighboring cities.

"As an illustration, except in Los Angeles, a large city where the rates are regulated, the voluntary base rate made by our competitor for lighting is 7 cents per kw-hr. This rate prevailed for the last year; previously higher rates were charged. In our city the rate is 5 cents. An average rate 2 cents higher for commercial sales for light would have given us additional receipts last year of $37,187.

"Practically all our consumers are small users. Therefore the average rate per kilowatt-hour for illumination would be higher than in a city like Los Angeles. The same thing is true concerning electrical energy sold for motor service. Ours is not a manufacturing city, and energy for motor service is sold to small users at a higher average rate than would be received on the entire system of the Edison company, where large users help to lower the average rate.

"The average rates received by this department will stand comparison with other central stations operating under similar conditions. The average rate from the sale of energy for illumination was 4.954 cents per kw-hr.; for motor-service, 1.942 cents per kw-hr.; for street illumination, 4.681 cents per kw-hr. Our books are open to all."

NITROGEN-FILLED LAMPS IN CHICAGO

Decreased First-Cost and Maintenance Charges, Improved Flexibility of Circuits and Distribution of Light, and Reduction in Energy per Lamp

More than 8000 300-watt, 600-cp, 20-amp series nitrogen-filled lamps are now in street-lighting service in Chicago in several sections of the city outside the central business district. During 1915, according to

FIGS. 1, 2 AND 3—NITROGEN-FILLED LAMP IN UNDERGROUND DISTRICT, STANDARD CONSTRUCTION IN OVERHEAD SECTIONS, AND TYPE OF POST USED

Mr. Ray Palmer, commissioner of gas and electricity, the department expects to add from 5000 to 10,000 more gas-filled lamp installations to the present equipment. During the year the city will purchase some 24,000 of the lamps, to be used for both renewals and extensions.

Many of the new incandescent lamps have been installed to replace old direct-current and 7-amp alternating-current arc lamps. Compared with the arc units the gas-filled lamps provide greater flexibility of operation, give more uniform distribution of light, cost less to install and maintain under Chicago conditions, and make possible the installation of about 30 per cent more units than would be possible with flaming arcs for a given quantity of power. The new 300-watt incandescent lamps, producing 600 cp, are being used to replace 450-watt inclosed-arc lamps giving only about 250 cp.

Fixtures of Special Design

The fixture used is of a special design, originated by the Chicago Department of Electricity, and consisting of an enameled copper casing inclosing a compensator and socket and equipped with reflector and globe holder for the diffusing outer globe. This fixture is also pro-

vided with a holder for an inner refracting globe, as it is believed that such refracting glassware, when perfected, will be an economical and practical adjunct to the gas-filled lamps. The only glassware in use at the present time is a diffusing outer globe, but experiments are being conducted on various kinds of glass, including refracting media. Following are data on costs: Cost of fixture without refractor, $10.20; cost of fixture with

FIG. 4—TYPE OF FLAMING-ARC LAMP REPLACED

refractor, $13.60; 300-watt, 20-amp lamp (April 1), $3.20; total, fixture and lamp, without refractor, $13.40; total, fixture and lamp, with refractor, $16.80.

Although the lamps themselves are purchased under a guarantee of 1000 hours' life, records kept by the department show that actual performances are being attained averaging between 1600 hours and 1800 hours

FIG. 5—TYPE OF INCLOSED-ARC LAMP REPLACED

per lamp, thus indicating that the number of lamp renewals per year is now approaching a point between two and three instead of the four renewals which the manufacturers had guaranteed not to exceed. This increased life per lamp, taken with the reduced price of the lamps effective April 1, shows the present marked tendency toward lower maintenance costs of nitrogen-filled street-lighting systems.

Reduction in Labor Costs for Patrolling and Cleaning

As many as 1200 of the nitrogen-filled lamps can be patrolled and defective lamps replaced by one man with a Ford automobile. For the use of the machine, which is supplied by himself, the patrolman is allowed $3.75 per day, in addition to his salary of $100 a month. The patrolman averages 45 miles per day in his automobile. Another man who has charge of the cleaning has a route of 750 lamps, handling them at the rate of fifty a day. Formerly a trimmer at $100 per month trimmed 330 arcs, and a patrolman at the same salary patrolled 500 arcs, thus requiring five men per 1000 arcs. Figured on the same basis, 1000 nitrogen-filled lamps now require the services of only two and six-tenths men, indicating a saving of 48 per cent in labor cost.

Electrical energy for Chicago's street lighting is purchased from the Sanitary District of Chicago, which has a water-power plant at Lockport, Ill., and is contracted for at the rate of $15 per hp-year delivered to the substations. Under the operating conditions existing, this is equivalent to energy at 0.5 cent per kw-hr.

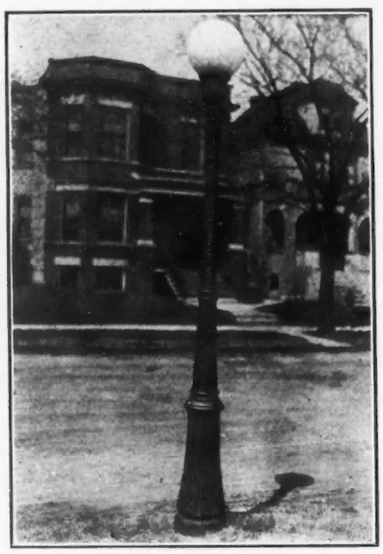


FIG. 6—ORNAMENTAL POST USED FOR NEW EQUIPMENT

The table gives the estimated comparative operating costs per unit lamp of the arc and gas-filled incandescent systems. The figures are based upon an allowance of three renewals a year for the gas-filled lamps, but, as already noted, the actual number of renewals is now less than three per year, with consequent reduction in cash costs. The term "fixed charges" as used includes

COMPARATIVE COSTS FOR CHICAGO LAMPS

	Arc (465 Watts)	Nitrogen (365 Watts)
Cash cost per year	$31.32	$29.48
Fixed charges per year	24.81	13.27
Total cost per year	$56.13	$42.75

proper interest and depreciation on plant, transmission line, substations and distribution investment.

In other sections of the city the 8100 4-amp, 80-watt, 80-cp vacuum-type tungsten lamps installed in 12-in. balls on ornamental post standards which were rebuilt from old gas-lamp posts are being replaced with 75-watt gas-filled lamps. These new units furnish 100 cp, thus attaining an increase of 20 per cent in candle-power with a saving of about 7 per cent in energy.

DIGEST OF ELECTRICAL LITERATURE

Generators, Motors and Transformers

Synchronous Converter.—W. LINKE.—The conclusion of his illustrated article in which the author discusses various methods of starting synchronous converters.—*Elek. Zeit.*, April 1, 1915.

Cost of Efficiency of Transformers.—W. E. BURNAND.—In this illustrated article the author deals with the cost of obtaining efficiency when the size of a transformer is varied. Curves are given to facilitate such calculations. The author also describes a mechanical efficiency calculator by which efficiency curves can be drawn mechanically for given iron and copper losses.—London *Electrician*, April 9, 1915.

Transformer Oil.—C. S. LAWSON.—An illustrated article on the care of transformer oil. The main points to be considered in the selection of transformer oil are dielectric strength, flash point, viscosity and sludging. The author describes testing devices for determining dielectric strength and then deals at some length with filter presses for removing moisture from oil. The best engineering practice demands regular inspection of transformers and the preservation of the records of such inspections.—*Elec. Journal*, May, 1915.

Lamps and Lighting

Flicker Photometer.—H. E. IVES AND E. F. KINGSBURY.—An account of flicker photometer measurements by a large group of observers on a monochromatic green solution. The results described emphasize an important point in colored-light photometry, namely, that precision in reading and agreement between different observers of a small group furnish no evidence whatever of accuracy. The emphasis placed upon this point is prompted by the widely found belief that if one observer reads with a small mean variation consistently from time to time it is evidence that his readings are "right," and the similar idea that if several observers who happen to be associated together read alike, their result must be "right." This conclusion is valid only where there is no color difference. The correctness of an individual observer's setting has nothing whatever to do with his skill or training—it is dependent upon the color sensibility of his retina. The agreement of several observers is a matter of chance, except where, using the equality-of-brightness or direct-comparison method, observers have consciously or unconsciously altered their criteria toward a common mean. The justice of this criticism is strikingly illustrated by the results obtained in these tests by five observers who constitute the entire group of photometrists from a laboratory in which measurements involving a considerable color difference were part of the regular routine. They agree with each other to within about 3 per cent, but their mean on this particular color difference is 8 per cent above the average for all. These considerations indicate the importance of a definite scheme of selecting observers from a group of at least twenty-five where lights of different color are to be evaluated. They also emphasize the desirability of methods of colored-light photometry by which individual observers may secure the results of the average eye as established by measurements on a large group.—*Phys. Review*, March, 1915.

Determining Radiant Luminous Efficiency.—ENOCH KARRER.—A description of a method for determining the radiant luminous efficiency of a light source by means of a cell the transmission curve of which is identical with the luminosity curve of the average eye. The author defines radiant luminous efficiency as the ratio of the energy of the radiation emitted, weighted in accordance with its effectiveness in producing the sensation of light, to the energy of the total radiation emitted. The author explains the luminosity curve of the average eye and sketches general methods for obtaining values for the radiant luminous efficiency of any light source. The purpose of his investigation was to construct a cell with suitable absorbing solutions to be used in the direct determination of luminous efficiency. The transmission of such a cell must be such as to allow quantities of the radiation of any wavelength to pass through proportional to the luminosity of that wave-length; that is, the transmission curve must be identical with the luminosity curve of the average eye. The thermocouple screened with this cell in series with the galvanometer will respond to the radiation proportional to the true light value; that is, as the eye responds to that radiation giving the sensation of light. The cell used in the investigation had three compartments which contained solutions of cupric chloride, potassium bichromate and ferric chloride respectively. The values of the radiant luminous efficiency found in this investigation are as follows: carbon filament, 0.45; nernst glower, 1.08; nitrogen-filled tungsten lamp, 2.93; open burner, 0.19; standard candle, 0.24; five different Welsbach mantles, 0.5, 0.7, 0.8, 1.2 and 1.26; three tungsten lamps, 1.99 (1 watt per candle), 1.84 (1.1 watt per candle), 1.65 (1.25 watt per candle); mercury arc, 30.5.—*Phys. Review*, March, 1915.

Molecular Gage.—SAUL DUSHMAN.—A theoretical consideration of the behavior of gases at very low pressures shows that a rotating disk exerts a torque on a disk suspended symmetrically above it that is proportional to the quantity $\Sigma(p\sqrt{M/RT})$, where p denotes the partial pressure and M the molecular weight of each constituent present in the gas and R and T have their usual signification. The paper contains the description of a vacuum gage based upon this principle, and also the results of a number of measurements carried out with its aid. It was found that in order to obtain the best possible results with a Gaede molecular pump, it is necessary not only to heat the vessel to be exhausted and connecting tubing to a temperature at which most of the moisture adsorbed in the walls is driven out but also to insert a liquid-air trap to prevent the diffusion backward of condensible vapors.—*Phys. Review*, March, 1915.

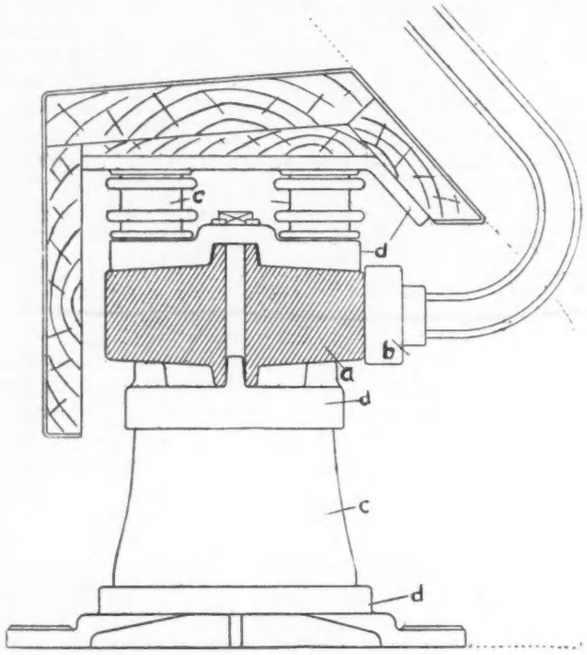
Generation, Transmission and Distribution

Electricity in South African Mines.—J. H. RIDER.—A paper read before the (British) Institution of Electrical Engineers on the power supply of the Central Mining Rand mines group. The author deals in general with the electrical energy that is used by this large group of mines. Reference is made particularly to the question of metering energy to electric hoists, hoist control, overwinding devices, depth indicators, mill drives, and switchgear for distribution of electrical energy to the mines. Lastly the author deals with the troubles that have been experienced. The article is to be concluded.—London *Electrician*, April 16, 1915.

Slate Mining.—R. C. BERLIN.—An illustrated article on the use of electricity in slate mines. The author discusses the use of pumps in slate-quarry installations, the use of air compressors, the power required in the plants for finishing and sawing the slate, the use of electric hoists, and the general advantages of electrifying a slate mine.—*Elec. Journal*, May, 1915.

Traction

Rapid Transit in Cities.—W. BETHGE.—German rapid transit roads generally use a third-rail of soft steel weighing 45 kg per meter (specific conductivity 8), with insulated supplementary conductors of copper, while for the return circuit the ordinary rails are used, weighing about 28 kg per meter (specific conductivity 5), with supplementary bare copper cables. The author finds that first cost and cost of maintenance can be considerably reduced if soft steel is used instead of the copper, while the weight of the third-rail is greatly increased. He shows how to determine the thickness of the third-rail and the distance between the substations in order to get the most economical cost of operation for the network and the substation. Third-rails weighing 45 kg per meter, as heretofore usually employed in Germany, are no longer sufficient for rapid transit in cities even for relatively small traffic. Much heavier third-rails can be used. Below is a design of the



THIRD-RAIL DESIGN

Allgemeine Elektricitäts Gesellschaft, whose engineers have investigated this problem for several installations and have developed several solutions. The illustration shows a particularly simple solution with a contact shoe *b* at the side of the third-rail *a* weighing 120 kg (264 lb.) per meter. *c* represents porcelain and *d* cast iron. —*Elek. Zeit.*, April 1, 1915.

Aerial Ropeway.—An illustrated description of an aerial wire ropeway for automatic disposal of ashes from the boiler house of the Neppsend Station of the Municipal Electric Works of Sheffield.—London *Elec. Review*, April 9, 1915.

Installations, Systems and Appliances

Handling the Small Consumer in Europe.—HUGO EISENMENGER.—The author, with S. E. Doane, made a trip through Europe last year and studied the different methods employed by central stations to popularize the use of electricity, especially with the small consumer. Inquiries were made at 660 different stations. The principal results were given in an extensive article by Doane in the ELECTRICAL WORLD, May 23, 1914, page 1157. The present author sums up in this article the results in the form of tables occupying four full pages. —*Elek. Zeit.*, April 8, 1915.

Temperature Measurements in the Modern Power House.—CHARLES S. JEFFREY.—The author discusses the measurement of boiler furnace temperature, boiler flue-gas and economizer temperatures, steam temperature, and the temperature of generator windings, bearings and oil supply, condensers and coal bunkers. The types of instruments best adapted for power-house work, in the author's opinion, are the mercurial glass thermometer, the indicating or recording mercurial thermometers of the Bourdon gage pattern, and the electrical resistance thermometer.—London *Elec. Review*, April 9, 1915.

Oil-Switch Explosions.—A. WEINBERGER.—Oil explosions are possible only when air is mixed with gasified oil. Gasified oil alone will not explode. The author therefore suggests building oil switches air-tight, removing the air and introducing an inert atmosphere of nitrogen. An automatic valve would regulate the pressure so that it would remain constant. Another method suggested is to make the oil switches air-tight and to connect them by means of vertical pipes to an oil reservoir at a higher level. In this way it would be impossible for air to get into the switch—*Elek. Zeit.*, April 8, 1915.

Wires, Wiring and Conduits

Dielectric Properties of Insulating Materials.—KARL WILLY WAGNER.—The conclusion of his illustrated article on the dielectric properties of insulating materials. In the present instalment the results of tests of rubber, hard rubber, paraffine, ceresin, fiber and especially paper (undried and dried, unimpregnated and impregnated) are given.—*Elek. Zeit.*, April 8, 1915.

Electrochemistry and Batteries

Fixation of Atmospheric Nitrogen.—W. S. LANDIS. —The author first discusses briefly the synthetic production of ammonia by the Haber process and the direct combination of nitrogen and oxygen in the air by arc processes, and then discusses at greater length the cyanamide process. The raw materials for cyanamide are cheap—coke, limestone, air. Only one-fifth the electrical energy is used that the arc processes use per unit of nitrogen fixed in the form of cyanamide, and by the addition of a very small percentage more of energy cyanamide can be converted into nitric acid. About the same quantity of labor is required to fix a unit of nitrogen in cyanamide as in the arc process for nitric acid, and only a small fraction more labor is required to transform cyanamide nitrogen into nitric acid. This is not a great handicap in view of the smaller energy consumption for cyanamide. On the American continent, where water-power is expensive and scarce, the difference readily offsets the additional labor necessary to make nitric acid from cyanamide. Moreover, cyanamide is easily transported and can be changed to ammonia or nitric acid at the end of its journey at the expenditure of a very small amount of steam and labor, so that there is the additional advantage in transportability of stable raw material and subsequent conversion at the point of direct use. There is no comparison between the initial investment required for a cyanamide plant and for an arc plant if the power development is included. The cyanamide plant requires an investment per unit of fixed nitrogen of only about one-quarter that required by the arc process, and for a cyanamide-ammonia plant about one-half that required by the Haber process. Even the combination of the cyanamide-ammonia-nitric-acid process requires an investment of from only one-third to one-half that for the arc process. In each case exactly the same quantity of fixed nitrogen is assumed in the forms above designated. Where electrical energy is expensive, as in the United States, there is no

question regarding the superiority of the cyanamide process for the fixing of amospheric nitrogen, particularly for fertilizer purposes. A full illustrated description is added of the lime plant and the coal-gas plant of the Niagara works of the American Cyanamide Company.—*Met. and Chem. Eng'ing*, April, 1915.

Electrotyping.—An article on the regulation of electrotyping solutions, based on Circular 52 of the Bureau of Standards.—*Met. and Chem. Eng'ing*, April, 1915.

Units, Measurements and Instruments

Moving Coil Galvanometer.—PAUL E. KLOPSTEG.—A brief abstract of an American Physical Society paper. Differences in throws on the two sides of the null position of a moving-coil galvanometer used ballistically result almost entirely from non-uniformity of the so-called radial field and from slight displacements of the coil from its position of symmetry with the field. For a given quantity of electricity, discharged in opposite directions, a certain angular position with reference to the "geometric null" may be found for which equal throws are obtained. This position is not fixed for different quantities. The logarithmic decrement usually increases with the amplitude, and the variation is not the same on the two sides of the null position. Consequently the ballistic constant may have a different value for each value of the ballistic throw over the entire scale. In a supposedly high-grade instrument differences as high as 20 per cent in the constant have been found. In a given deflection or ballistic instrument the best condition for proportionality of deflections and throw with steady and instantaneous currents respectively obtains when the axis of the coil is coincident with the axis of symmetry of the magnet. To keep these axes coincident when the coil assumes different angular positions it is necessary that the upper suspension terminals be short—so as to avoid the possibility of bent terminals—and parallel to the fiber, and that the lower suspension be so constructed as to exert no lateral force upon the coil. This last-named condition is closely complied with if the torque is made small, and if there is no deformation in the regular turns of the spiral. The adjustment of the position of the coil in the field when once carefully made should be easily reproducible when disturbed. A very convenient method is to provide the galvanometer with an adjustable leveling device such as a spirit level, or a plumb-line with a movable indicator. The level or indicator may be set permanently when the desired adjustment of the coil is accomplished. The bifilar action of a twisted-strip upper suspension has been found negligible in its effect upon galvanometer sensitivity. The effect of difference in torques for twisting and untwisting of the lower suspension (1.5-mil strip, seven turns) has been found comparable with experimental error.—*Phys. Review*, March, 1915.

Measuring High-Frequency Currents.—ALBERT CAMPBELL AND D. W. DYE.—The authors investigated the measurement of high-frequency currents such as are used in radiotelegraphic work by three methods, thermal instruments immersed in oil, air-core transformers and iron-core transformers. They conclude that properly designed air-core transformers, when used with due care, in conjunction with thermal ammeters, afford a simple means of measuring currents of the order of from 1 amp to 50 amp with good accuracy at frequencies of from 50,000 cycles up to 2,000,000 cycles per second. Iron-cored transformers, which have some advantages in ease of construction, can also be designed to fulfil the same purpose and to give very satisfactory results. To a limited extent both types are useful for measuring very small high-frequency currents.—London *Electrician*, March 19, 1915.

Induction Meters.—An official communication of the Reichsanstalt describing an induction meter for single-phase alternating current of the Isaria Company and admitting it for calibration.—*Elek. Zeit.*, March 18, 1915.

Magnetic Testing of Sheet Iron.—J. SUMEC.—The author shows that the magnetic permeability can be determined with the ordinary Epstein apparatus with sufficient accuracy, if the maximum induction in the iron sheets is measured and the real ampere-turns per centimeter of the coils are used in the calculation. In an appendix the author notes that he has devised a universal galvanometer shunt for constant damping (which may be chosen at will) for variable sensitiveness. It may be used with any galvanometer.—*Elek. Zeit.*, April 1, 1915.

Measuring Power-Factor.—R. D. GIFFORD.—The first part of what promises to become a long illustrated serial on the measurement of power-factor. The author proposes to deal with the subject under the following headings: Dynamometer and moving-iron types of power-factor indicator; the induction-dynamometer power-factor indicator; meaning of the power-factor of a three-phase unbalanced circuit; theory of the six-unit power-factor meter; results of tests substantiating the theory; the four-unit power-factor meter on three-phase unbalanced circuits; frequency tests on the induction-dynamometer power-factor meter; power-factor meters with artificial scales; the induction-dynamometer synchroscope. The article is to be continued.—London *Electrician*, April 16, 1915.

Telegraphy, Telephony and Signals

Telephone Engineering Economics.—HARVEY A. SMITH.—In this article, illustrated by maps and diagrams, the author considers the problems involved in the lay-out of a telephone area. The methods employed in taking into account the future development of the area, of determining the most economical situation of the exchange, of making provision for new exchanges and for extensions to old ones, of the alteration of the boundaries of an exchange area, etc., are all explained with the aid of diagrams illustrating an assumed area.—London *Electrician*, April 9, 1915.

Miscellaneous

Electro-Percussive Welding.—C. E. SKINNER AND L. W. CHUBB.—Their American Electrochemical Society paper on electro-percussive welding is reprinted, and in an editorial attention is called to the extremely small amount of energy that is used in the process. The power at the moment of fusion is considerable and is placed by the authors at 23 kw in a certain case, but the time taken for the flow of current is extremely small. The current is akin to a flash of lightning, which provides an enormous flow, but for an infinitesimal time. Consequently, the authors estimate that the cost, with energy at 10 cents per kw-hr., is only a few millionths of a cent per weld. One of the important features of the process is, of course, the fact that the heating is extremely localized. It is on this account that the welding of aluminum is thereby rendered possible. The method is not, however, limited to the welding of aluminum, but is destined to be useful for many other purposes; in fact, for those conditions in which any extensive heating is out of the question.—London *Electrician*, April 9, 1915.

British Patents in 1914.—An abstract of the thirty-second report of the British Comptroller-General of Patents, Designs and Trade-Marks, W. Temple-Franks. The report deals with the war and British legislation, trend of inventions in 1914, patents, designs and trade-marks.—London *Electrician*, April 9, 1915.

Book Reviews

WELDING. Theory, Practice, Apparatus and Tests. Electric, Thermit and Hot-Flame Processes. By Richard N. Hart. Second edition. New York: McGraw-Hill Book Company, Inc. 210 pages, 127 illus. Price, $2.50.

Since the first edition of this book appeared in 1910 great strides have been made in electric-arc and hot-gas-flame welding. New processes have been developed and numerous important improvements have been made in apparatus and in welding practice. At the time of the first edition the Thomson incandescent process had been developed to a very high degree for the making of repeat welds such as are encountered in manufacturing processes. The chief limitation of this process lies in the difficulty of maintaining an equal distribution of temperature. Where large areas are involved or where the heat-dissipating qualities of the two sides of the weld are different spot welding has done much to remove these two limitations, and new developments along this line are well covered in Hart's book. The hot-flame processes, among which oxy-acetylene is the leader, were developed to a thoroughly commercial degree at the time of the first edition, and the plants described were capable of doing many kinds of repair work. Great improvements in the hot-flame processes have been along the line of welding and cutting machines for use in manufacturing processes, thus permitting the hot flame to compete with the Thomson process in some instances; but the principal effect has been the creation of an entirely new field of work. Of all the processes, that of electric-arc welding has made the greatest progress. The methods described originally were practically the same as had been in use for nearly a quarter of a century. In the present edition the latest advanced uses of the flux-coated metallic electrode are covered, and many data regarding energy control and consumption and the time required for various classes of work are given. Mr. Hart's book covers in a very complete and logical fashion the various processes of welding and soldering. The subject is introduced by a short consideration of forge welding, followed by a discussion of the various metals with special reference to their welding properties. The weldnig processes covered include electric-incandescent, electric-resistance and electric-arc welding, oxy-acetylene, oxy-hydrogen and blaugas processes, the thermit process, the Lafitte welding plate, the Ferrofix brazing process, and ordinary brazing and soldering.

HANDBOOK OF MACHINE-SHOP MANAGEMENT. By John H. Van Deventer. New York: McGraw-Hill Book Company, Inc. 374 pages, 244 illus. Price, $2.50.

This book will be welcomed not only by those who are machine-shop managers but also by those in the workmen's ranks who desire to qualify themselves for advancement. There has been a growing desire to study the different methods of machine-shop administration, and the technical journals have devoted much space to this subject, which is of so much importance to all connected with machine-shop practice. Mr. Van Deventer has gathered from this great mass of literature those things that are most closely related to present-day practice in the leading shops. The book is well written. The language is clear and to the point and much is expressed in a few words, yet the meaning is always plain. The large number of diagrams and illustrations also helps to make clear many things that would otherwise need extended description. The various divisions of the book are well classified and the index is very complete. In addition, the use of bold-face headings to indicate the topics discussed in the paragraphs makes it easy to locate information without recourse to the index. The book will undoubtedly be appreciated by all who are interested in machine-shop management.

PREVENTING LOSSES IN FACTORY POWER PLANTS. By David Moffat Myers. New York: The Engineering Magazine Company. 560 pages, 68 illus. Price, $3.

There are many books dealing with economies in power-plant management, but they are almost invariably written for the engineer and are therefore couched in technical phraseology such as the engineer uses and understands. Now, it is a lamentable fact that many engineers who realize the wastefulness and inefficiency of their plants and who know the methods to be pursued to improve conditions meet with no encouragement and even with opposition from owners or managers who are unacquainted with the engineering phases of factory management. It is primarily for such owners and managers, then, that Mr. Myers has written this book, his aim being to present the engineering and economic arguments in such a clear and forceful manner as to induce these officials to encourage and assist operating engineers in their efforts for increased efficiency in the power plant. The first ten chapters, written particularly for executive officials, deal with the determination of existing losses, attainable efficiency, the boiler plant and the piping, the engine plant and its preventable losses, the heating system, and the effect of the human factor on the operation of the plant. The remaining nine chapters are more technical in their nature and are intended especially for the factory engineer or superintendent. They cover such subjects as boiler tests, combustion, burning of gas and waste fuels, modern prime movers, boiler-feed pumps, steam-consumption tests, and reports. The book cannot fail to open the eyes of directing officials to methods of economy which they have heretofore neglected, and it also will prove of value to those whose duty it is to put into effect such methods of saving as may be decided upon.

Books Received

Centrifugal Pumps. By R. L. Daugherty. New York: McGraw-Hill Book Company, Inc. 192 pages, 111 illus. Price, $2.

Electricity for the Farm. By Frederick Irving Anderson. New York: The Macmillan Company. 266 pages, illus. Price, $1.25.

Directions for Designing, Making and Operating High-Pressure Transformers. By Prof. F. E. Austin. Montpelier, Vt.: The Capital City Press. 46 pages, 21 illus. Price, 50 cents.

Recent Telephone Patents

Messrs. K. H. Atherton and M. N. Rodgers have jointly patented a receiver support which is arranged to raise or depress the hook switch. The switch is operated as the receiver is turned to the position in which it is used.

Mr. A. E. Case has patented a step-by-step selecting mechanism for party lines. The apparatus locks out all but the called party's instrument by sending out impulses of different character to each party.

A combined intercommunicating and private exchange system has been invented by Mr. S. A. Koltonski, of Boston. Mechanical means are provided for maintaining a resistance across the trunk when an incoming call must be extended to another station.

POWER AND OPERATING SECTION

Wiring Machine Tools in Metal Conduit

A DEFECT in many machine-tool installations electrically driven by individual motors is the failure to protect properly the wiring at the tool from injury which may lead to short-circuits or interruptions of service. With the forms of flexible and rigid conduit now on the market this state of affairs should soon be a thing of the past. The use of metal clips to attach rubber or weatherproof insulated wire to a machine frame and the leaving of loose ends of circuits at starting box, switch and motor terminals when a tool is entirely self-contained electrically invite trouble under hard service. Sometimes motor leads are carried from the wall, ceiling or floor outlet in conduit to a switch on the machine frame, then snugly drawn through a flexible metal duct to a point within 6 in. or 8 in. of the motor terminals, and thence fanned out in open formation, to use a military term, to the bushings in the motor frame itself. Abrasion of such leads by dropped tools or by unwieldy metal stock undergoing handling at or in the machine may lead to annoying interruptions of service. With the increased attention now being paid to refinement of details in the design of electrically driven tools, this source of possible trouble should soon give way to a uniform standard of protected wiring in both new and old installations.

Foresight in Selecting Boiler-Room Instruments

WHEN some form of boiler-room accessory such as a damper controller, a flue-gas analyzer, a water-level regulator, or the like, is installed, the immediate object in view is a saving due to more uniform and efficient operation; but there are other points that are sometimes overlooked, namely, the amount of care required by the device to keep it in good working order and the quality of the attention that it is likely to receive. Some of the appliances classed broadly under the name of steam specialties need to be watched closely and well protected from dirt if they are to perform their work continuously and accurately. On the other hand, the operating force in the boiler room is too often of a low grade of intelligence, the main qualification being the physical ability to fire a given quantity of coal in a given time. If this were not true, and firemen were thoroughly acquainted with the principles underlying the economical management of boilers and furnaces, there would probably be a smaller demand for these devices that are designed to take the place of human attendance and insure automatic or semi-automatic regulation. If any such appliance is made a part of the plant equipment, there should be some one sufficiently familiar with its construction and action, and likewise sufficiently careful, to see that it is maintained in perfect operating condition. To turn over an expensive or intricate device to the supervision of an untrained employee not only defeats the purpose of the device but appears remarkably like a deliberate ignoring of the biblical caution concerning the casting of pearls.

Valve Leakage Versus Valve Setting

NUMEROUS types of valves have been invented to replace the old-fashioned D slide valve so common on simple steam engines, and all sorts of complicated valve gears have been devised to give certain desired motions to the valves. The object in every case has been to improve the steam distribution and to obtain an increased amount of work from every pound of steam admitted to the cylinder. It is not uncommon, therefore, to hear engineers discuss, with eloquence and understanding, the relative advantages of slide-valve, Corliss and four-valve engines. But there are some points that should not be overlooked. Steam must be admitted into the cylinder in order to do work, and it must be kept there and expanded to the limit set by the particular valve gear used, in order to obtain the maximum effect possible. Leakage from the steam side directly into the exhaust, without passing through the cylinder, and leakage past the piston or valves into or out of the cylinder constitute direct sources of loss and inefficiency. The economy that should be obtained by an improved valve or valve motion may easily be more than offset by leaking of the valves. There seems to be ample reason for the remark, made by a lecturer on steam-engine performance, that it is possible to effect a greater saving in the steam consumption of the average engine by taking proper precautions to prevent valve leakage than by altering the cut-off, release and compression by tinkering with the valve setting.

The Theory of Boilers

IN a paper read before the Institution of Engineers and Ship Builders of Scotland, Mr. R. Royds recounted the results of a recent series of experiments on the transmission of heat from flue gases to the heating surface of the boiler, carried out with the intention of obtaining experimental data on the Reynolds formula for heat transmission, which is based largely upon theoretical considerations. The important features of this formula are that the rate of heat transmission is proportional to the difference of temperature between the heating fluid and the surface in contact with it, and also to the mere weight of the heated gas passing, so that the heat transmission is practically independent of the pres-

sure of the gas, a thing which *a priori* might be somewhat in question. Mr. Royds' test data confirm the Reynolds formula and give an independent check on the assumption that with a given weight of gas flow the rate of heat transmission is constant irrespective of the pressure. Mr. Royds also analyzed a number of experimental trials bearing on the same general problem and called particular attention to some of the difficulties of working on a fairly large scale with actual boilers, especially the great difficulty of determining the true temperatures of the gases. In work of this kind experiments on fairly constituted models are by no means to be despised, provided that one understands the nature of the variations to be expected in transferring to apparatus of commercial size. The difficulties of the subject under study are steadily yielding before persistent investigation, so that the conditions requisite for high efficiency in boilers are becoming better understood, despite the fact that sacrifices have sometimes to be made for reasons quite apart from the theory of thermodynamics.

Combined Steam and Hydroelectric Service

In this issue appears a most instructive account of the investigation made by the city of Calgary, in western Canada, to determine the minimum cost of obtaining its electric-energy supply. Calgary has a chance for rather unusual economies in that it can obtain cheap transmitted energy from the Calgary Power Company, and also can use either coal or natural gas in its steam station. At present both sources of energy are utilized, and the problem before the city was to discover the most economical way of combining them. The steam plant contains a little over 13,000 kva in generating equipment, including three modern turbines. Half of the boiler equipment is fired by natural gas and the other half by coal. The latter fuel costing about $3.75 per short ton and the former 15 cents per 1000 cu. ft., the two fuels happen to be nearly equal in final cost, the gas having a slight advantage. The city has a contract to take for the next few years not less than 5000 hp and not more than 8000 hp as primary power from the Calgary Power Company. The cost situation is somewhat complicated by the fact that the power company has different rates for summer and winter, the first 5000 hp in each case being sold at the uniform rate of $26 per hp-year.

The available methods of operation in combining the two sources of energy were, first, to use transmitted electric energy, holding the steam plant in reserve; second, to carry the whole load by the steam plant; third, to take up the contract minimum from the Calgary company and supply the rest from the steam plant, and, fourth, to carry the maximum contract load and utilize the steam plant for the remainder. The first scheme could be practicable only in summer, since not more than the minimum can be depended upon in winter. The second was for the time being barred by the contract with the hydroelectric plant. The third was the arrangement necessary in winter and desirable in summer. The fourth involves less use of the steam plant, while still demanding its aid at certain periods. At times the Calgary company can supply more than the maximum contract amount, 8000 hp, but it cannot spare it with certainty. The conditions of operation in the Calgary plant proved to be favorable for combined operation. The load-factor on a typical winter day would be reckoned at approximately 0.7 and the power-factor ran very high, above 0.9, since the street-railway system, which absorbs a considerable amount of energy, receives its direct-current supply through synchronous motor-generator sets.

The problem which had to be solved is somewhat analogous to that presented in the case of many hydroelectric stations having auxiliary plants, except that in this case the customer instead of the energy-supply company operates the auxiliary station. As is always true in such cases, the serious factor resides in the standby charges of the steam plant. These fall heavily upon the periods of no load or light load on the station. The fuel costs in operating by steam proved to be quite low, being about 0.5 cent per kw-hr. The curves of costs found for operating the plant in the various ways mentioned, including capital charges, ran rather surprisingly close, indicating perhaps that the Calgary company had made a shrewd guess in fixing its rates. So long as the summer rates of the company should prevail, it appeared to be most economical to carry the whole load by means of transmitted energy, provided that the demand did not rise in excess of that stipulated in the contract entered into on the basis of permanent service.

When operating at top efficiency and at fair load on winter rates the steam plant could well hold its own. The close run of the figures is in no wise better shown than in noting that with natural gas at 10 cents per 1000 cu. ft. instead of 15 cents the steam plant is more economical than the hydroelectric plant at the contract price. In fact, at current prices the conditions are such that considerable watching of the load situation is required to determine the condition of maximum economy. It seems that the use of the whole minimum of transmitted energy and as much more as may be available, with the steam plant taking up the remainder of the load when necessary, gives, on the whole, the best combination. However, the high standby cost attached to the steam power adds such an amount to the average cost as to render the total figure considerably greater than would seem probable from the low contract price of the transmitted energy. Investigations carefully and conscientiously made, as in this case, on the cost of combined service bring to the front the great finesse required in planning combination or auxiliary plants, whether these are owned directly by the energy-supply company or, as in this case, by a large consumer. When one deals with a hydroelectric supply very variable in amount instead of with a fixed supply by contract, much wisdom is required to discover the conditions of minimum cost even with a high constant load-factor.

The Cost of Combination Electric Service

Investigation at Calgary to Determine Best Way of Taking Energy from a Hydroelectric Transmission System and City's Steam Station

ONE of the most flourishing communities in western Canada is the city of Calgary, Alberta. The city has at present two sources of electrical supply, one the Calgary Power Company's terminal station in East Calgary and the other its own steam plant at Victoria Park.

The municipality is bound by contract to take at least 5000 hp from the Calgary Power Company for the next four years, and, in addition, the standby charges of the present steam station, which must be held in readiness in case of failure of the transmission system, must also be paid. There was therefore much speculation as to the most economical way of taking electricity from the two sources, the hydroelectric company having different summer and winter rates.

The accompanying curves and calculations are the result of an investigation made under the direction of City Electrician Robert Brown for determining with a fair degree of accuracy the cost of electrical energy to the city of Calgary up to the point of delivery to the distribution system of the electric-light department under different conditions of load and methods of operation.

Fig. 4 is a typical load curve for a winter day, showing that there is quite a demand for energy between midnight and morning for the following reasons: The street lighting demand is over 1000 kw and is on an all-night schedule for the most of the year; water-pumping machinery in the city is driven electrically and storage tanks are filled at off-peak hours; several large mills and factories operate all night, and the electric-vehicle-charging load is an all-night load and is beginning to become appreciable. The load-factor (ratio of average load to peak load) is therefore very high, being between 0.6 and 0.7. The load-factor for the particular day the load curve of which is shown was 0.707. That on the hydroelectric system was 0.89, and that on the steam station was 0.40. The yearly load-factor was probably a little less than this, and as the load increases from year to year there is no doubt that the load-factor will decrease.

The power-factor of the city's system is high, being between 0.9 and unity, because the street-railway system is supplied with direct current from synchronous motor-generator sets.

During the times in which the peak load of the Calgary system is reached there are three 1000-kw sets and one 500-kw set in operation.

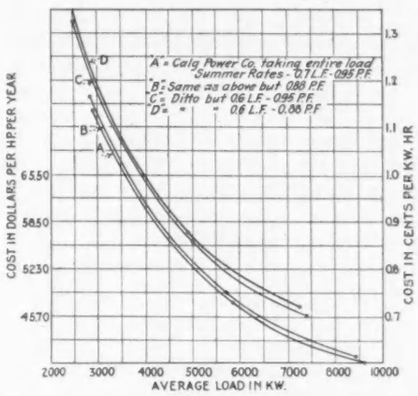

"A" = Calg Power Co. taking entire load Summer Rates - 0.7 L.F. - 0.95 P.F.
"B" = Same as above but 0.88 P.F.
"C" = Ditto but 0.6 L.F. - 0.95 P.F.
"D" = " " 0.6 L.F. - 0.88 P.F.
COST IN DOLLARS PER HP PER YEAR
COST IN CENTS PER KW. HR.
AVERAGE LOAD IN KW.

FIG. 1—EFFECT OF POWER-FACTOR AND LOAD-FACTOR ON HYDROELECTRIC RATES

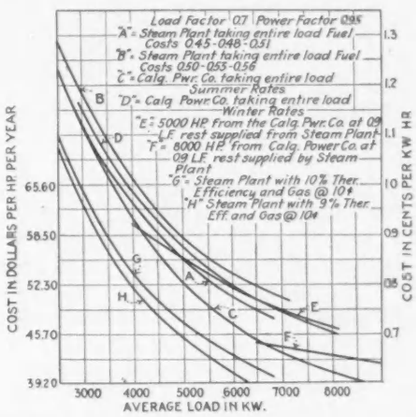

Load Factor 0.7 Power Factor 0.95
"A" = Steam Plant taking entire load Fuel Costs 0.45 - 0.48 - 0.51
"B" = Steam Plant taking entire load Fuel Costs 0.50 - 0.53 - 0.56
"C" = Calg. Pwr. Co. taking entire load Summer Rates
"D" = Calg Powr Co. taking entire load Winter Rates
"E" = 5000 HP From the Calg. Pwr. Co. at 0.9 L.F. rest supplied from Steam Plant
"F" = 8000 H.P. from Calg. Power Co. at 0.9 L.F. rest supplied by Steam Plant
"G" = Steam Plant with 10% Ther. Efficiency and Gas @ 10¢
"H" = Steam Plant with 9% Ther. Eff. and Gas @ 10¢
COST IN DOLLARS PER HP PER YEAR
COST IN CENTS PER KW. HR.
AVERAGE LOAD IN KW.

FIG. 3—COST OF GENERATING ELECTRICITY BY STEAM, GAS AND WATER-POWER

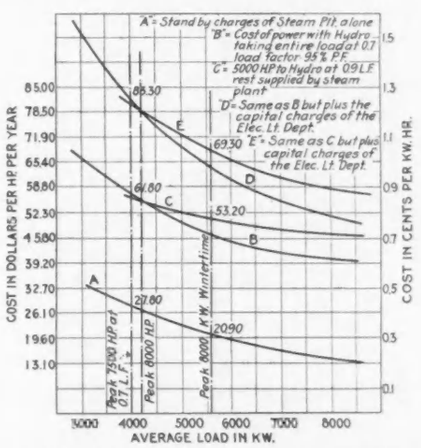

"A" = Stand by charges of Steam Plt. alone
"B" = Cost of power with Hydro taking entire load at 0.7 load factor 95% P.F.
"C" = 5000 HP to Hydro at 0.9 L.F. rest supplied by steam plant
"D" = Same as B but plus the capital charges of the Elec. Lt. Dept.
"E" = Same as C but plus capital charges of the Elec. Lt. Dept.
Peak 7500 HP at 0.7 L.F.
Peak 6000 HP.
Peak 8000 K.W. Winter time
COST IN DOLLARS PER HP PER YEAR
COST IN CENTS PER KW. HR.
AVERAGE LOAD IN KW.

FIG. 2—STANDBY CHARGES ON GENERATING SYSTEM

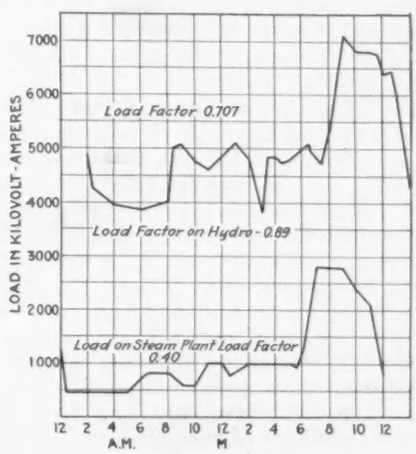


FIG. 4—TOTAL LOAD CURVE FOR FEB. 14, 1914

By overexciting the synchronous motor the wattless kva of the system can be entirely compensated for.

The contract with the Calgary Power Company will be in force for the next four years. The following are some abstracts from it:

Rates.—Winter Rates—First 5000 hp at $26 per hp-year; next 1000 hp at $25; next 1000 hp at $24; next

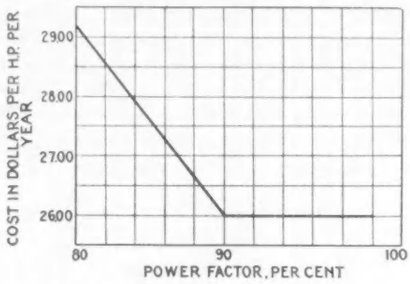


FIG. 5—EFFECT OF POWER-FACTOR ON HYDROELECTRIC RATES

1000 hp at $23; next 1000 hp at $22; next 1000 hp at $21; all over 10,000 hp at $20.

Summer Rates (April-October)—First 5000 hp at $26 per hp-year; all over this, $15 per hp-year.

The basis of charge per month is on the maximum thirty-minute peak during the month. In the Calgary Power Company's terminal station there is a curve-drawing ammeter connected to one phase of the feeder to the city's lines. The power supplied is figured as the voltage multiplied by the maximum thirty-minute reading of the ammeter multiplied by the square root of three multiplied by the power-factor at this particular load. As long as the power-factor does not go below 90 per cent, the actual power-factor is used in figuring the power supplied. When the power-factor does drop below 90 per cent the factor 0.9 is used, even though the power-factor be only 80 per cent. Fig. 5 shows how the rates vary with the power-factor of the city's lines. The minimum load to be paid for is 5000 hp, and 8000 hp is the maximum load that the power company will supply.

Steam Plant

At present the municipal steam plpant contains the following: one 6250-kva steam generator turbo set, one 2800-kva steam generator turbo set, one 3125-kva steam generator turbo set, one 600-kw steam-driven street-railway generator, one 500-kva vertical steam-driven alternator.

Half of the boiler equipment is fired by natural gas (1100 lb.-Fahr. heat units) at 15 cents per 1000 cu. ft., and the other half by coal. In making up the curves actual figures were obtained from the power department as to labor, maintenance and the cost of supplies for three winter months, and for the month of April when the water-power company took the entire load and the steam plant was kept in readiness.

The fuel costs for these months were also calculated accurately. Some time ago an ideal full-load test was made on the 3125-kva steam turbo set, and the fuel cost of 0.47 cent per kw-hr. was obtained. This shows what the plant can do under favorable conditions.

The possible methods of operating now are as follows:

(1) Allowing the Calgary Power Company to take the entire load and keeping the steam plant in readiness. This method is possible only in summer, as the water-power is not sufficient to supply more than the minimum contract load in winter.

(2) Allowing the steam plant to carry the entire load. If there were no contract with the hydroelectric company, this method would be possible.

(3) Allowing the water-power company to supply the minimum contract amount of power of 5000 hp, the rest being supplied by the steam plant. This is possible in summer and necessary in winter.

(4) Allowing the water-power company to carry the maximum contract amount of power (8000 hp) and supplying the rest by steam plant. This is the method which will have to be used when the summer power demand exceeds 8000 hp, unless the Calgary Power Company raises its maximum.

The coal has a heat value of about 12,500 lb.-Fahr. heat units per lb. and costs about $3.75 per ton of 2000 lb. With gas at 15 cents per 1000 cu. ft. the coal is equal to about $3.40 worth of gas.

In the winter the Calgary Power Company carries 5000 hp and the rest is supplied by the steam plant. At times of low load the total power demand drops below 5000 hp. It is hard to keep the Calgary Power Company's load at exactly 5000 hp so that the load-factor on the supply from the Calgary Power Company is about 0.9. The load on the Calgary Power Company is regulated by adjusting the governor on the turbines in the steam plant. During the summer the Calgary Power Company is allowed to take the entire load and the boilers in the steam plant are kept in readiness. The cost of labor, maintenance and supplies is, of course, reduced somewhat under these conditions.

The cost of energy from the steam plant is made up of several items—capital charges, fuel costs, maintenance, supplies and labor. In making up the curves the capital charges, maintenance, supplies and labor were averaged from the actual figures from the power department. Fuel costs have to be assumed more or less, as they cannot be determined so accurately as the other costs. In the case where the Calgary Power Company is allowed to take the entire load the cost of energy is made up of charges to the water-power company and the standby charges of the steam plant. In figuring capital charges the capitalization of the power department was reduced by $70,000, because it included the cost of some street-railway motor-generator sets, which are correctly classed as part of the distribution system.

A consulting engineer who was called in to report on power estimated the fuel costs to be 0.45 cent for a 10,000-kw gas-fired steam plant, working on 30 per cent

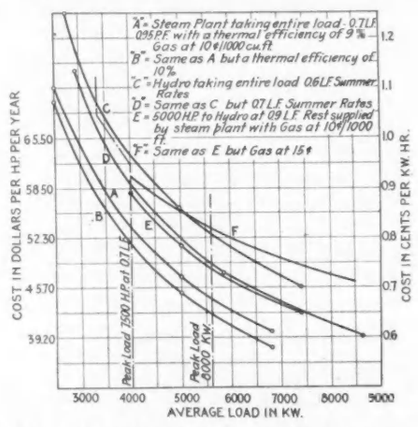

A = Steam Plant taking entire load 0.7 L.F. 0.95 P.F. with a thermal efficiency of 9% Gas at 10¢/1000 cu.ft.
B = Same as A but a thermal efficiency of 10%
C = Hydro taking entire load 0.6 L.F. Summer Rates
D = Same as C but 0.7 L.F. Summer Rates
E = 5000 H.P. to Hydro at 0.9 L.F. Rest supplied by steam plant with Gas at 10¢/1000 ft.
F = Same as E but Gas at 15¢
COST IN DOLLARS PER H.P. PER YEAR
65.50
58.50
52.30
45.70
39.20
COST IN CENTS PER KW HR.
1.2
1.1
1.0
0.9
0.8
0.7
0.6
Peak Load 7500 H.P. at 0.7 L.F.
Peak Load 8000 KW.
3000
4000
5000
6000
7000
8000
9000
AVERAGE LOAD IN KW.

FIG. 6—COST OF GENERATING ELECTRICITY BY STEAM AND WATER-POWER

load-factor with gas at 15 cents per 1000 cu. ft. and 1100 lb.-Fahr. heat units per cu. ft. In an ideal test of the 3125-kva turbo-generator at full load, 0.455 cent per kw-hr. and 0.47 cent per kw-hr. were obtained as fuel costs. A fuel cost of 0.45 cent per kw-hr. gives a thermal efficiency of 10 per cent with gas at 15 cents and 1100 lb.-Fahr. heat units per cu. ft.

Fig. 8 shows thermal efficiencies for different prime

movers. The efficiency of the boiler (about 75 per cent) and auxiliaries, such as exciters, vacuum pumps, hotwell pumps, etc., must also be taken into account. It can be seen from the above data that 10 per cent thermal efficiency is not too high an estimate.

When the plant is operating at small load, however, the fuel cost will naturally be higher, so in making curves a fuel cost of 0.45 cent at an average load of 7500 kw, 0.48 cent at an average load of 5000 kw and 0.51 cent at an average load of 2500 kw were used for the case when the load-factor equals 0.7 and the power-factor 0.95. At 0.6 load-factor, costs of 0.46 cent, 0.49 cent and 0.52 cent were used. Some curves were drawn up assuming 9 per cent thermal efficiency, with fuel costs of 0.50 cent, 0.53 cent and 0.56 cent. These last costs represent the maximum, because in the figures supplied by the power department fuel costs of 0.53 cent and 0.56 cent have already been obtained with average loads of 1700 kw and 40 per cent load-factor. With gas at 10 cents fuel costs of 30 cents, 32 cents and 34 cents were used.

Fig. 5 shows how the water-power company's rates increase with decrease in power-factor. Fig. 3 shows how the total costs vary with power-factor and load-factor.

Calculations

As to the accuracy of the curves and calculations certain assumptions of course had to be made. The cost of energy is made up of the Calgary Power Company's power charge and the steam-plant charges, which consist of capital charges, labor, maintenance and supplies. The Calgary Power Company's charge amounted to $303,250 in this case. The capital charges of the steam plant were taken from the auditors' figures and amounted to $98,000 of $153,200 assumed for the steam-plant charges; $33,000 was for labor, and these charges were taken from actual figure supplied by the power department. The remaining $30,000 is for maintenance, supplies and office charges. These charges were estimated from the power-department figures.

The costs with the steam plant taking the entire load are made up of the fuel costs plus the above steam-plant charges. Fuel costs cannot be estimated exactly, so

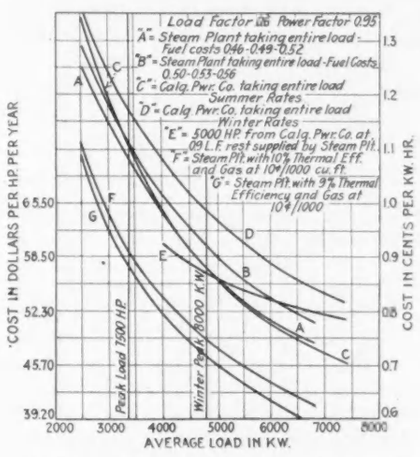

Load Factor as Power Factor 0.95
"A" = Steam Plant taking entire load - Fuel costs 046-049-052
"B" = Steam Plant taking entire load - Fuel Costs 0.50-053-056
"C" = Calg. Pwr. Co. taking entire load Summer Rates
"D" = Calg. Pwr. Co. taking entire load Winter Rates
"E" = 5000 HP from Calg. Pwr. Co. at .09 L.F. rest supplied by Steam Plt.
"F" = Steam Plt. with 10% Thermal Eff. and Gas at 10¢/1000 cu. ft.
"G" = Steam Plt. with 9% Thermal Efficiency and Gas at 10¢/1000
COST IN DOLLARS PER HP. PER YEAR
COST IN CENTS PER KW. HR.
65.50
58.50
52.30
45.70
39.20
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
Peak Load 7500 HP
Winter Peak 8000 KW
2000 3000 4000 5000 6000 7000 8000
AVERAGE LOAD IN KW.

FIG. 7—COST OF GENERATING ELECTRICITY BY STEAM AND WATER-POWER

that the maximum and minimum charges for fuel were assumed and curves drawn for the two figures.

The justification for the different fuel costs was given above under the heading "Thermal Efficiencies." The variation in maximum and minimum fuel costs is not over 8 per cent of the total cost of power. The minimum fuel costs assumed have already been proved by tests on the plant under favorable conditions, so that the curves using the minimum fuel costs are not in error more than 3 per cent or 4 per cent.

Summary and Conclusions

The curves show the necessity of keeping the power-factor and load-factor high.

In the case of the power-factor, as long as the street-

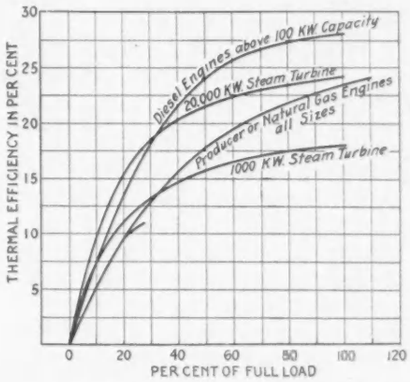


FIG. 8—THERMAL EFFICIENCY OF PRIME MOVERS NOT INCLUDING AUXILIARIES

railway load keeps pace with the total load there will always be enough synchronous motor load to give a leading current to compensate for the wattless kva of the system. If it does not keep pace, it might be possible during peak-load hours in the summer to run one of the turbo sets without steam turned on and overexcite the generator, or the connecting rods on the 700-kva vertical-steam-engine-driven alternator might be taken off and the alternator operated as a synchronous condenser.

Fig. 1 shows that in summer it is most economical to let the Calgary Power Company take the entire load if gas costs 15 cents. With gas at 10 cents it would be cheaper to run the steam plant alone. This would be possible if the hydroelectric contract did not exist. In winter the curve shows the economy of allowing the hydroelectric system to take 5000 hp at 0.9 load-factor and supply the rest of the energy from the steam plant. This is the only method that can be used on account of the hydroelectric contract.

Fig. 7 shows the cost of energy from the steam plant with 10-cent gas. This shows that in the summer 10-cent gas would not improve matters much as long as the load-factor is high.

Fig. 6 shows that at the usual summer peak loads of 7500 hp the cost of the steam plant forms nearly half the cost of energy and the total cost of energy up to the point of delivery to the distribution system of the electric-light department is about 0.94 cent per kw-hr., or $61 per hp per annum. Adding the capital charges of the electric-light department brings the total cost up to nearly 1.3 cents per kw-hr., or $83.30 per hp per annum.

Underground 23,000-Volt Transmission at Toledo

The Toledo Railways & Light Company recently put into successful operation a 23,000-volt, three-phase underground transmission system for supplying 12,000 kw to the Willys-Overland automobile factory at Toledo. Five thousand kilowatts of the total substation rating is already installed and in operation, and an order has been placed for three more 1000-kw transformers to be installed at the Willys-Overland substation. It is planned, furthermore, that within six months another 3000 kw shall be added, which will complete the 11,000-kw station as planned six months ago.

THE FORMATION OF CLINKER IN COAL

Reasons Why Ashes Fuse, Methods of Predetermining Fuel Characteristics, and How to Prevent Clinkers

By S. U. Tuspin

Almost every fireman of experience knows what clinker is, perhaps through intimate acquaintance with it in the course of his daily labor. He knows that it works down into the air space of the grate, collects there, and throttles the air supply to the fuel, so that he is forced to spend an unusual amount of energy in cleaning the fires in the effort to maintain the ordinary rate of combustion and keep up the required steam pressure. Or else it adheres in chunks to the brick lining of the furnace with such tenacity that the brickwork is broken or endangered by efforts to loosen the clinker.

But while he may be familiar with the general manifestations of clinker and the troubles that follow in its train, he may not be so familiar with its inner nature and the various factors that lead up to its formation.

Silica with Basic Oxides Causes Clinkers

To begin with, then, clinker is a solid that is produced by the cooling of slag that is a result of a process of fusion. To form it, the coal must contain slag-forming materials and the temperature of combustion must be high enough to cause fusion. The two substances absolutely necessary for the production of any slag are silica and a basic oxide, and the relative proportions of these substances determine the temperature at which fusion will occur.

The slag-making constituents of coal are found in those incombustible portions that remain as ash. The silica that must be present to produce slag is in the form of sand, and the oxides exist as lime, clay, magnesia, sulphur dioxide and iron oxide. The temperature of the furnace of the ordinary steam boiler is in the neighborhood of 2000 deg. or 2500 deg. Fahr., which is not sufficient to cause the fusion of silica alone nor of the oxides alone; but let two or three of the oxides be brought in contact with sand under the conditions existing in a boiler furnace, and the fusing point is so greatly reduced that they melt and form silicate, which is the chemical term for slag.

The relative proportions of silica and oxides have a marked influence on the temperature at which melting occurs. If the amount of silica is greatly in excess of the amount of oxides, the ash will be very difficult to fuse; or if there is a large amount of the less fusible oxides, such as lime, clay and magnesia, the result will be the same. In fact, the temperature of the furnace may not be great enough for fusion in either case. But if oxide of iron predominates, the temperature of fusion will be greatly lowered and the formation of slag will be more probable. Another interesting fact in connection with this subject is that an increase in the number of different oxides present with the silica will lower the fusing point. Thus two oxides and silica will fuse at a lower temperature than one oxide and the silica.

Predicting Tendency to Clinker

Much trouble could be avoided if it were possible to predict the clinkering of any grade of coal before it was actually tried in the boiler furnace. One method proposed to accomplish this end involves the chemical analysis of the ash from the coal, to determine the percentages of slag-forming constituents. If the silica and the oxides are found to be present in such proportions that they will unite chemically, without leaving any considerable excess of either, the conclusion is drawn that the coal will give trouble by the formation of clinker. But if the results of the analysis show that either the silica or the oxides are largely in excess, then the conclusion is that trouble from clinker need not be feared.

Since there must be fusion to form clinker, a suggested method of determining whether a coal will clinker is to make a fusion test of the ash, that is, to find the temperature at which the ash will fuse. If this temperature is equal to or less than the temperature ordinarily developed in the furnace of the boiler, the coal is deemed unsuitable for that particular service.

Of the two methods of determining the clinkering properties of coal—the analysis of the ash and the fusion test of the ash—each has its champions who can point to instances in which the methods have proved accurate by actual application. Yet neither method seems to have secured general recognition by those who draw up fuel specifications for power-plant work.

On the other hand, there is one way of determining, without chance of failure, the clinkering properties of a coal, and that is by actually burning it in the boiler in which it is to be used. It is then subjected to all the influences of draft, grate, temperature, and the like, that exist during the normal working of the boiler, and its suitability or unsuitability for the work can be clearly established. This may appear to be an expensive method, but it has the merit of being absolutely convincing, and when compared with the cost of accurate chemical analysis of the ash it may not be so expensive, after all.

Temperature of Furnace Affects Fusion

There can be no doubt of the statement that the temperature of fusion of the ash has an important bearing on the question of clinkering. For it has been found that a coal that was utterly unsuitable as a locomotive fuel, because of the amount of clinker that it produced, could be used to good advantage in a stationary boiler, without forming clinker. The difference in the action of the coal, of course, was due to the changed conditions. In the locomotive the temperature produced during combustion is greater than that ordinarily found in power-plant boilers. At the higher temperature clinker was formed, whereas at the lower temperature the heat was not sufficient to fuse the ash.

Another fact that has come to light through the results of experience is that the mixing of two coals may cause clinkering, though neither coal by itself may clinker. Apparently this is due to the fact that one coal contains an excess of silica and the other an excess of oxides, so that, when mixed, the proportions are just right for the formation of a fusible slag.

Methods of Preventing Ash Fusion

In view of all these facts, then, it becomes possible to consider methods of avoiding the formation of clinker. If the coal is of such composition that the silica and the oxides are about rightly balanced to produce an easily fusible slag, the mixing of another coal having an excess of either silica or oxides might be sufficient to disturb the balance and reduce clinkering.

Again, the fact that a change of furnace temperature may prevent clinkering offers a way out of the difficulty. The furnace temperature depends on the rate of combustion, and a reduction in the rate of combustion may so reduce the temperature obtained as to render usable a coal that could not be employed under the unchanged conditions.

As the temperatures developed in furnaces fed by mechanical stokers are probably higher than those in hand-fired furnaces, clinker is apt to occur more frequently in the former. In one such case salt was found to be a preventive of clinkering. The clinker adhered to the side walls of the furnace, and attempts to dislodge it with the firing tools endangered the brickwork.

Quite by accident, some low-grade salt formed as a by-product in the works was thrown on the coal pile. When the coal was fed to the boiler the clinker gradually disappeared.

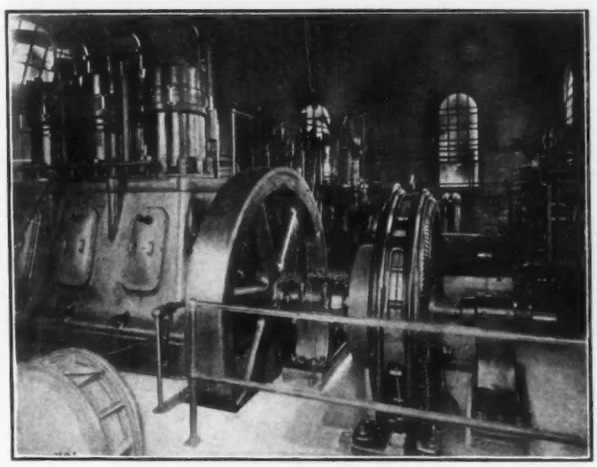
The manner in which the fireman handles his fire may have a great influence on the formation of clinker. The violent shaking of the grate or the too frequent use of the slice bar may so disturb the fuel bed that the ash will be brought to the surface and mixed with the hottest coal. As a result, the ash will be subjected to a much higher temperature than that existing at the surface of the grate, and the likelihood of fusion will be greatly increased.

The introduction of steam beneath the grate by a jet, or the formation of vapor from water kept in the ash-pit, has long been in use to prevent the clinker from adhering to the grate bars. Neither practice will prevent the formation of clinker, though it may palliate the troubles that result.

EXPERIENCES OF SMALL-PLANT OPERATOR

Economies Effected by High-Efficiency Engine Unit Made Motor Load Profitable Despite Low Rates

As typical of the vicissitudes encountered in the operation of small central-station electric-lighting plants, the experiences related by Mr. E. B. Pollister, of Minneapolis, Minn., before the convention of the Iowa Section of the National Electric Light Association are



DIESEL-TYPE PLANT AT ROBINSON, ILL.

humanly interesting and at the same time contain suggestions of value. In Mr. Pollister's own brisk English his story is given herewith:

Experience with a Diesel-Type Engine

"In 1910 the writer as manager of the central-station and water-pumping plant at Robinson, Ill., operated a 133-cycle, simple, non-condensing steam plant every night, all night, and was a sustaining member of the 'if-you-want-to-avoid-trouble-stick-to-steam' club. Robinson was in a farming community that was increasing in population, following the discovery of oil and gas. The population of the town reached a maximum of 5000 in 1912. But as early as 1910 a competing natural-gas company, offering flat-rate contracts for cooking and heating with 'lights thrown in,' forced a safety-first policy upon the electric company and a sixty-cycle, three-phase, 160-kw Diesel-type generating unit was installed.

"Owing to the change in frequency and voltage the steam equipment was scrapped. As an added attraction to lighting customers we instituted day service, operating the 225-hp Diesel engine on a twenty-four-hour schedule, with a Sunday shut-down inspection period of five hours.

"Steam engineers who were operating the equipment were skeptical and expected the Diesel engine within a month to shut down, break down, blow up and develop indigestion, hesitation-waltz tendencies or any of the various other tantrums then accredited to such equipment. An unbroken run encouraged, however, the development of a day load. We hooked up a few small motors and then the Wilcox Glass Company began flirting with us to obtain motor service.

A Case Where a Rate Expert Was Needed

"Mr. Wilcox, of this company, in stating his case said: 'Our natural-gas engine is worn out; the manufacturers have gone out of business; we've practically got to buy a new 40-hp engine, and we expect to close out our interests here in two years. We've got $16,000 invested in gas wells and pipe lines to the factory, use a couple of million feet of gas a day, worth possibly 1.5 cents per 1000 cu. ft., and figure the gas used by the engine costs us 15 cents per twenty-four hours. The machine-shop foreman looks after the engine and makes repairs. Now we'll give you 50 cents a day to pull us.'

"We needed the load badly and, having discussed load-factor, shrewdly figured that the prospective customer would be willing to pay about four times what he had offered. We finally made him a rate on a sliding scale ranging from 2.5 cents to 1 cent per kw-hr., which we estimated would net us about $75 a month. He signed the contract, which provided that his gas engine should be held in reserve to operate during peaks if needed.

The Customer Receives His First Monthly Statement

"Strained relations followed the first monthly billing of $213. When Wilcox came to the office he said: 'There's your bill—there's your check! Come down and get your motor or we'll pitch it out of the window!"

"Prior to this rather disappointing call from our new customer we had investigated the effect of the new load on our operating expenses. The station fuel bill for the month had increased from $72 to $93. Additional fixed charges and upkeep on lines, transformers and meter equipment—with hazard allowance—showed the cost of carrying the new load, on the basis of oil available at 2 cents per gal., to be less than $30.

"Furthermore, we needed that load and, as is usual in small cities, the total available motor load did not exceed our peak rating. We compromised, therefore, on a rate netting $0.007 per kw-hr. This rate resulted in an average billing of $110 per month, including factory lighting at 6 cents per kw-hr., which amounted to approximately $10 a month. Our total monthly fuel bill for the plant was then between $90 and $100.

TABLE OF EARNINGS, ROBINSON ELECTRIC COMPANY

Year Ending	Gross Income	Operating Expenses	Gross Earnings
July 31, 1909.....	$19,474.13	$13,212.25	$6,261.88
July 31, 1910.....	25,519.56	17,242.42	8,277.14
July 31, 1911.....	30,190.13	12,895.65	17,294.48

The Low Rate Finally Brings Profit

"With the engine producing 10 kw-hr. per gal. of oil the profit at the 7-mill rate, above the fuel cost of 2 mills, was 5 mills per kw-hr. At such a profit this twenty-four-hour, 40-hp load with its off-peak option was, of course, unusually attractive. The bulk of our

other energy output was bringing from 2 to 4 cents per kw-hr.

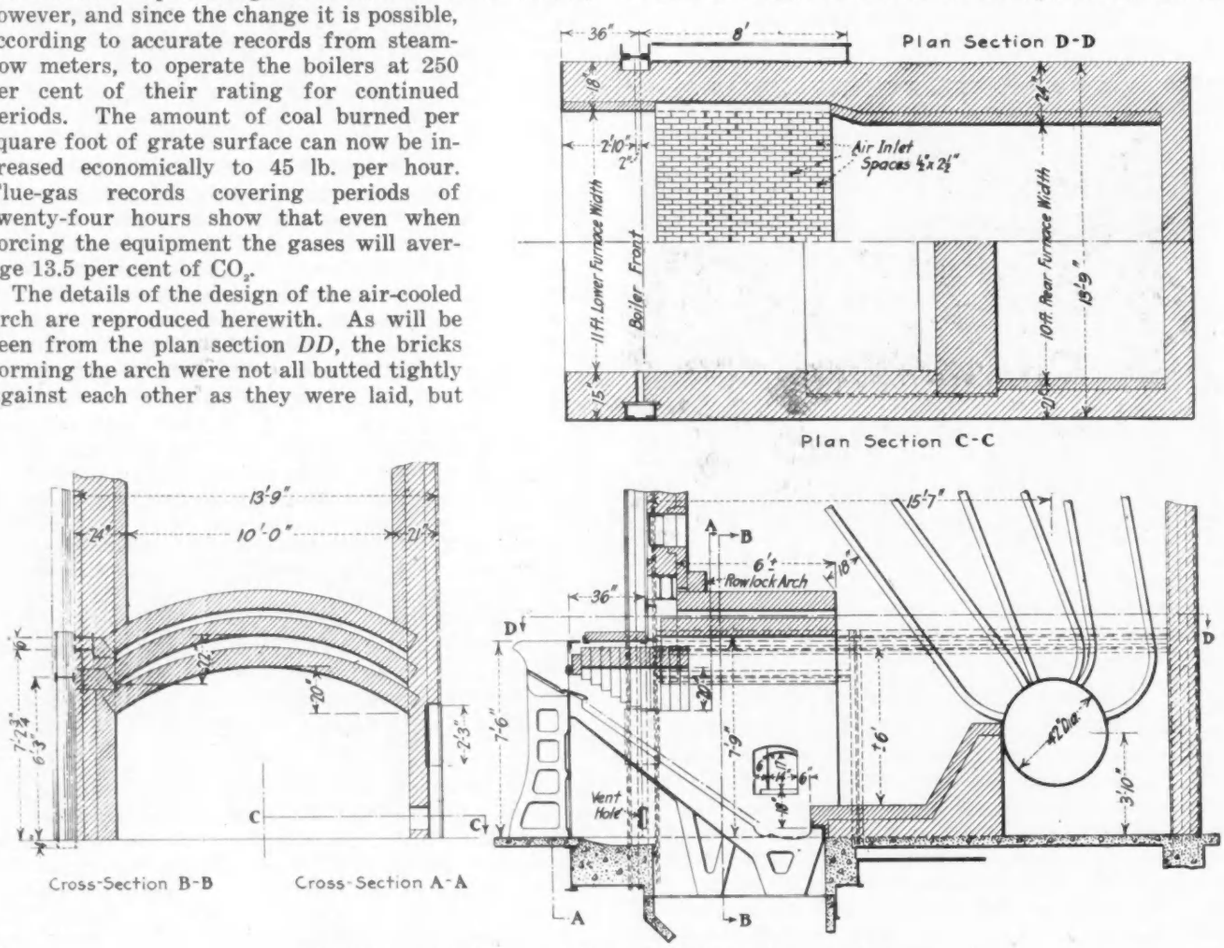
"The unit operated on this schedule for two and one-half years, with but one interruption of service caused by engine trouble. A hot bearing stopped the unit for two hours. At the end of a three-year period the gross earnings had been increased to about $18,000, and the plant was sold for $100,000 cash at a forced public sale.

"A glance at the accompanying table of earnings of the Robinson company will show a decrease in operating expenses, an increase in revenue, and an increase in gross earnings, following the installation of the Diesel engine in August, 1910.

Air-Cooled Furnace Arches Increase Efficiency

Under the direction of Mr. M. L. Addington, chief engineer for the Merchants' Heat & Light Company, Indianapolis, Ind., changes have been made in furnace design at the company's Washington Street plant which have greatly increased the boiler-room efficiency. With the original installation loads of 25 per cent over rating represented the limit to which the boilers could be forced. It was also impossible to burn economically more than 30 lb. of coal per sq. ft. of grate surface per hour. Air-cooled arches over the furnaces and grate bars of more open design have now been substituted, however, and since the change it is possible, according to accurate records from steam-flow meters, to operate the boilers at 250 per cent of their rating for continued periods. The amount of coal burned per square foot of grate surface can now be increased economically to 45 lb. per hour. Flue-gas records covering periods of twenty-four hours show that even when forcing the equipment the gases will average 13.5 per cent of CO_2.

The details of the design of the air-cooled arch are reproduced herewith. As will be seen from the plan section *DD*, the bricks forming the arch were not all butted tightly against each other as they were laid, but



DETAILS OF DESIGN OF AIR-COOLED ARCHES AT INDIANAPOLIS

air spaces 0.5 in. by 2.5 in. were allowed to remain open in alternate rows of bricks so that draft can be circulated down through the arches. In the Indianapolis station these arches have produced what the men call a "smokeless furnace" because they permit the passage of a sufficient supply of air to complete the combustion of the first gas given off by the heated coal. In point of life the ventilated arches are said to be far superior to any other type that is in use.

Ready for Emergencies at Cleveland

On a large glass-covered map in the office of the chief troubleman of the Cleveland Electric Illuminating Company are marked the locations of every hospital, ambulance and substation of the company, while by means of movable vacuum-cup markers record is kept of the movements of the various trouble and line crews at work in the city. Each foreman calls up hourly to report his location and to get instructions. When a report of an accident is received the man in the office refers quickly to the map and finds the nearest hospital or ambulance. A reference sheet gives him its name, street location and telephone number. Within a minute's time after the receipt of a call messages will have been dispatched to the ambulance office, hospital, company physician and the nearest company representative, without fuss or delay in looking through the telephone directory for names and numbers. On the vacuum-cup markers yellow cards represent company automobiles, red cards horse-drawn vehicles, and yellow cards men on foot or using street cars for transportation. In the event of widespread line trouble a bank of eight extra telephone positions is kept in readiness, where clerks taken from other routine duties can receive and record trouble calls emanating from customers as fast as these come in.

Results of Accident-Prevention Work in Commonwealth Edison Organization

For a number of years the Commonwealth Edison Company, Chicago, has made a practice of installing mechanical and physical safeguards for the protection of employees, but about fifteen months ago accident-prevention work in the organization was undertaken along a new line—that of educating the employee himself to be more careful and thus to protect himself and his fellow workers from avoidable accidents. It was largely in recognition of the application of this interesting principle of reaching the individual employee that the award of the Travelers' Insurance Company's gold medal was made to the Commonwealth Edison Company during the recent safety exposition at New York, as noted in our issue of Dec. 26.

Every employee of the Commonwealth Edison Company is a member of its safety organization, which is conducted under the direction of a central committee on safety. The first year's committee comprised Messrs. P. Junkersfeld, chairman, Mr. W. L. Abbott, Mr. J. H. Goehst, Mr. George B. Foster, Mr. W. C. Berry, Mr. H. L. Gannett, and the officers of the company N. E.

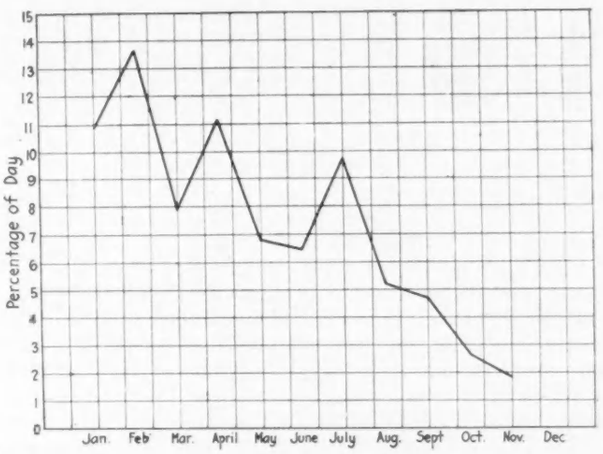


FIG. 1—CURVE SHOWING PERCENTAGE OF DAY LOST PER MONTH PER EMPLOYEE, 1914

L. A. Section, Messrs. F. J. Arnold, W. A. Fox, P. J. Smith and T. J. Walsh.

The various employees' safety organizations meet at intervals of a few weeks to hear lectures and to discuss topics relating to greater safety in their particular lines of work. Suggestions for relieving undesirable conditions, effecting reductions in possible hazards, etc., are also submitted. Suggestions which are considered worth carrying out are approved, while those which are questioned are next submitted to the intermediate safety committees, which co-operate with groups of employees' organizations on the one hand and with the central safety committee on the other. In this way a suggestion of any merit finds its way to the central committee before being finally turned down. These intermediate committees are made up of foremen and others of similar rank. Each employees' committee elects a chairman, vice-chairman and secretary to serve six months, while the intermediate committees elect officers for terms of one year.

For convenience in conducting its work, the central committee delegates much of its work to an executive committee called the Commonwealth Edison Safety Bureau. This committee is made up of the central committee chairman, the company's inspector of safety, the head of the claim department, and the manager of the bureau of safety. The last-named is a separate but co-operating organization which has general charge of safety work in all the Insull companies. It maintains separate offices and staff and is conducted by Mr. C. B. Scott.

The actual results of the safety efforts which have been carried on during the last twelve months in the Edison company are best shown by the accompanying

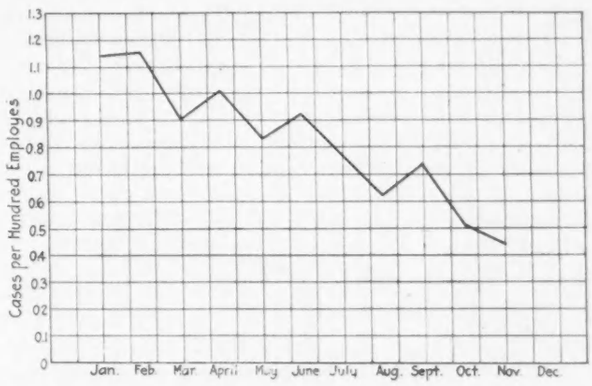


FIG. 2—CURVE SHOWING NUMBER OF DISABILITY CASES PER HUNDRED EMPLOYEES, 1914

curves revealing the reduction in disability cases and, in time lost by employees since the inauguration of the new plan. The number of injury cases, it will be noted, has been reduced by more than half, while the amount of time lost per employee per month has been reduced from one-seventh of a day to one-fiftieth of a day, an improvement of about 700 per cent.

Don't Let Careless Excavators Cause You Underground Trouble

Failure on the part of a building contractor to provide properly against the earth caving into an excavation for a tall building gave the central-station company in a Western city a serious trouble on its underground-cable system. When the upright wall of earth at the front of the premises gave way, the slide took with it

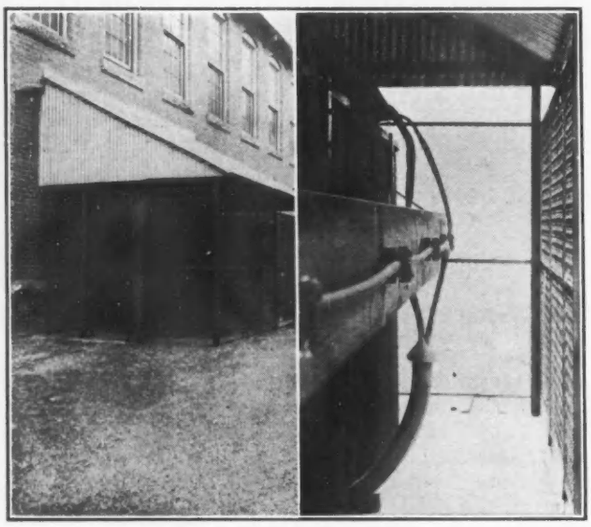
CABLES SAGGING AND STRIPPED OF CONDUIT

material from the under-surface of the street beyond the sidewalk line. Among the other things carried into the foundation excavation were the conduit and cables. The underground department of this company now makes it a practice to watch building operations where similar slides are apt to occur so that it can warn careless contractors before damage is done.

Motor Service in a Large Bolt Factory

Electrical Distribution System of the Reed & Prince Manufacturing Company, Worcester, Mass.—Motor-Maintenance Methods

ONE of the largest industrial plants on central-station service in Worcester, Mass., is that of the Reed & Prince Manufacturing Company, maker of wood and machine screws, rivets, bolts, burrs, plugs, taps and other similar products. This establishment normally employs about 350 hands, has a total floor area of about 200,000 sq. ft., and occupies an extended site about one-fourth mile from the Webster Street generating station of the Worcester Electric Light Company. Some sixteen buildings are now in service, and the company operates 108 motors with an aggregate rating of 1154.5 hp. In general, three-phase, 550-volt induction motors are used, and on account of the simultaneous operation of similar machines in rows, economy of motor investment and simplicity of arrangement possible under the local conditions, group drive was adopted when the plant was electrified.



FIGS. 1 AND 2—OUTDOOR TRANSFORMER INSTALLATION, SHOWING PRIMARY CONNECTIONS

The electric-light company's service enters an interior substation by a three-phase, 300,000-circ. mil underground cable leading from the 2300-volt feeder buses of the Webster Street plant to the factory. The incoming leads are brought out in the substation at a pothead forming the terminal of the conduit and are carried thence to a three-pole disconnecting switch mounted on the ceiling. Beyond the latter the incoming line is split into two sections, one of which feeds the main transformers of the factory through an automatic oil switch controlling the primary leads, the other supplying the local transformers for the lamp circuits in another building on account of the previous supply of lighting energy from a former isolated plant operated by the factory. The main transformers for motor service are mounted on a concrete floor in a caged-in area just outside the substation.

Service Connections

The substation, exclusive of the transformer bay, is 16 ft. long, 12 ft. wide and 10 ft. high, having a concrete floor and roof with brick walls. It is admirably illuminated by four 100-watt lamps mounted about 8 ft. above the floor, two being in front of the switchboard and two at the rear. The substation contains a four-panel switchboard with a single set of 550-volt, three-phase buses at the rear and a feeder rack carrying series transformers with connections to the local power circuits, all of which are run in conduit. The incoming 2300-volt circuit is metered, one panel being devoted to the watt-hour meter and to time-limit relays and oil switches controlling the motor and lamp feeders respectively. All outgoing feeders are provided with automatic oil switches controlled by time-limit relays, and in general each circuit is equipped with a watt-meter. The instruments are of the edgewise type, and the board, which is about 7.5 ft. long, contains a busbar voltmeter and was equipped by the General Electric Company. It is attached to the wall at the rear by ¾-in. pipe framing terminating in a 2-in. by 4-in. timber, and the feeder and series transformer rack at the rear is composed of 1¼-in. by ⅜-in. strap iron. Considerable space was saved by mounting the series transformers on the rack, and the clearance at the rear of the rack, 3 ft. 8 in., is ample. A ground detector is also provided.

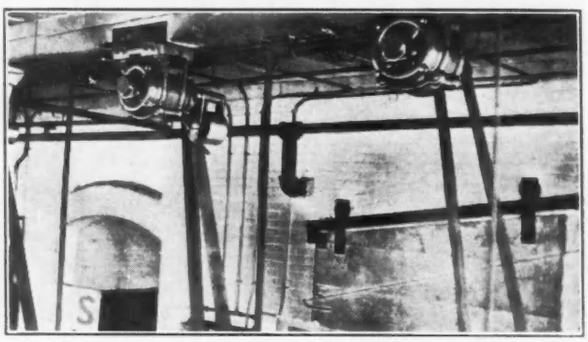
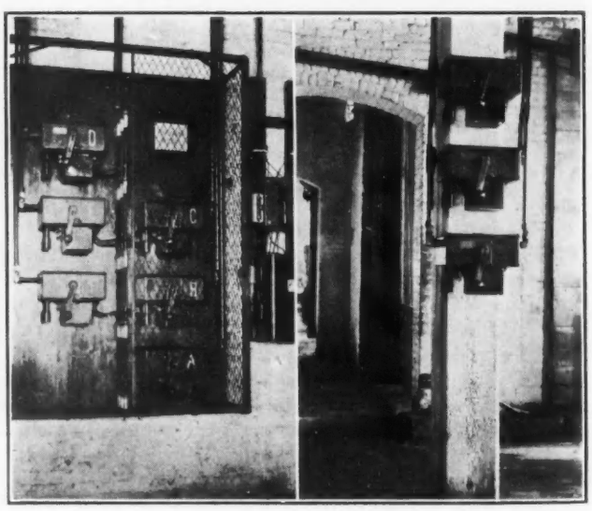


FIG. 3—5-HP MOTORS DRIVING COMBINED WOOD-SCREW SHEARERS AND SLOTTERS



FIGS. 4 AND 5—TYPICAL INSTALLATIONS OF OIL SWITCHES

The transformer bay, 18 ft. 8 in. by 9 ft. 8 in., pro-

vides ample ventilating facilities, combined with protection from the elements and from interference by employees, accidental or otherwise. It contains three 250-kva Westinghouse oil-cooled transformers with primary and secondary leads from and to the substation interior, and is inclosed by a wire fence 6.6 ft. high, the top being

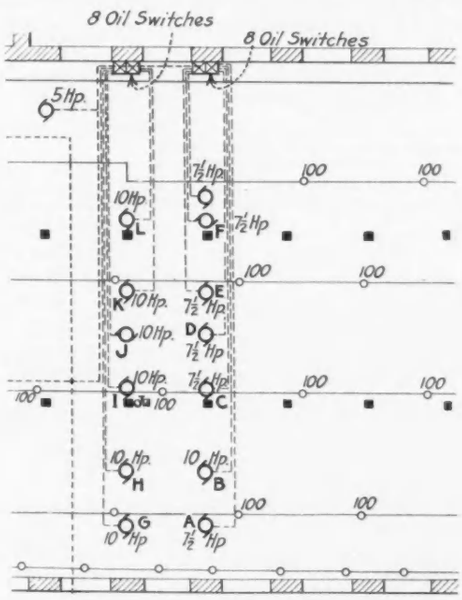


FIG. 6—SCHEME OF WIRING MOTORS FROM GROUPED OIL SWITCHES

roofed over by corrugated, galvanized-iron sheeting carried on a light truss supported at the ends and middle by 2½-in. by 2½-in. by ¼-in. posts. The roof height varies from 7.5 ft. to 12 ft. above the ground, and the fencing is so arranged that a section 4 ft. wide can be removed at one end in case it becomes necessary to take

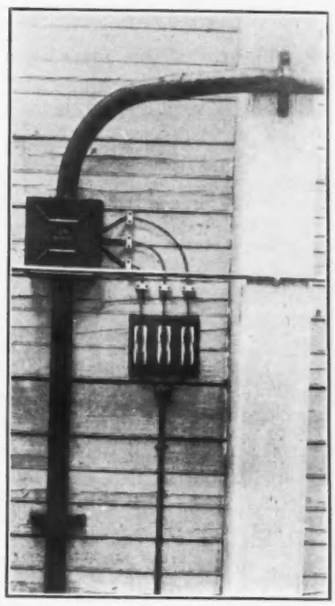


FIG. 7—TYPICAL CEILING JUNCTION BOX

out a transformer. A padlocked gate at one end also provides safe access to the inclosure. The transformers are connected in delta on both sides, and the primary leads are carried on a 2-in. by 10-in. plank from which connection is made to the 2300-volt conduit line from the switchboard. In general, the transformers clear each other by 28 in., and the secondary leads, which are on the switchboard side, are carried through the wall in porcelain bushings inclined about 30 deg. outward, and thence are dropped down to the 550-volt buses, which are horizontal and connected in solid with the transformers.

Motor Circuits

Five motor circuits leave the substation, ranging in capacity from 85 kw to 257 kw and in size from No. 2 B. & S. to 300,000 circ. mils. In general a conduit is carried upward along the outer wall of the building to an outside junction box from which the interior connection is made. This avoids the difficulties of attempting to pull large cables through sharp bends in the duct and saves something in fittings, besides rendering the feeds

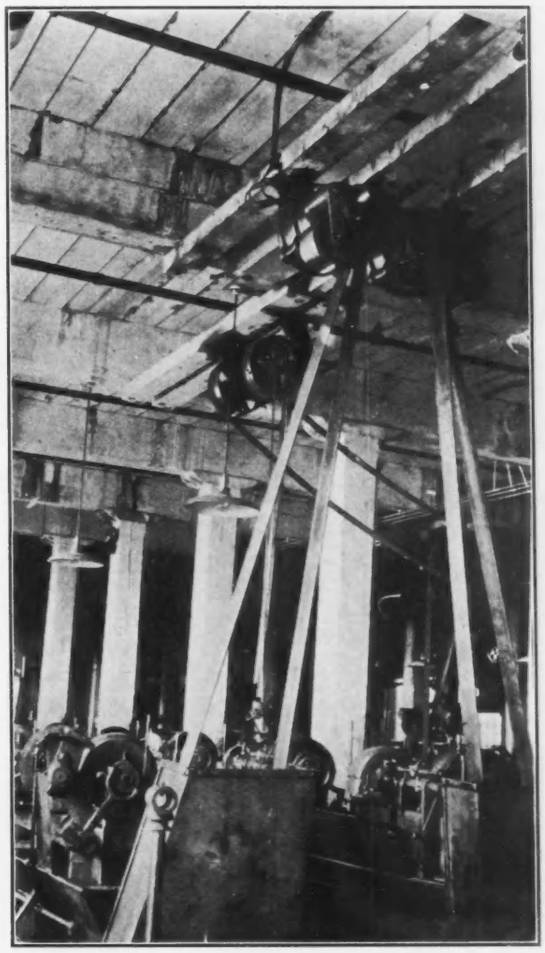


FIG. 8—5-HP MOTORS DRIVING AUTOMATIC SCREW MACHINES

accessible from outside the buildings, which are of mill-type construction. Interior risers are, of course, carried wherever necessary, the outside junction box work applying merely to the main feeders.

The largest motor is rated at 100 hp and the smallest at 1 hp, General Electric motors being mainly used. All motors larger than 10 hp are equipped with compensators, but these have been found unnecessary in most cases where a 10-hp outfit or less is operated. All local feeders are run in conduit, except in a few sections of the plant which have not yet been changed over to the conduit system, and automatic oil switches are being generally used now in place of fuses and disconnecting switches for individual motors. There are nearly thirty departments in the plant, but about eighty motors are in use in Departments 6 and 9, devoted to the

production of wood screws, the principal operations in these branches of the factory being shaving and threading.

Arrangement of Motors

Idler pulleys are used on substantially all motors of 5-hp rating and less, and on some larger motors, to provide better belt tension. Improved lapping of the belt around the pulley is thus secured with an actual decrease in friction compared with the ordinary loose belt on medium drives. In the various departments where motors are arranged in closely associated groups the oil switches are mounted together behind a screen, all taps being made by short connections from a set of vertical phase wires, with conduit runs from the load sides of the switches to the adjacent motors. In some

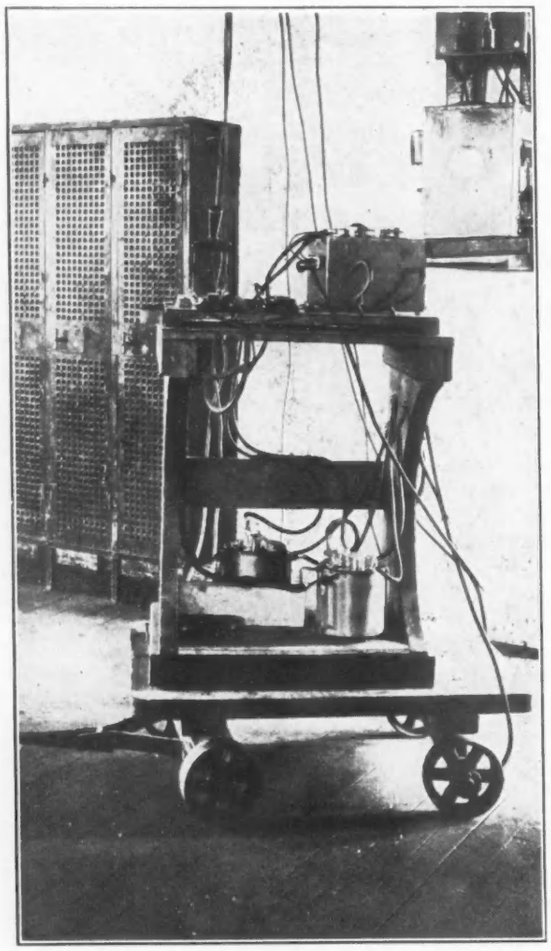


FIG. 9—PORTABLE TABLE FOR RAPID TESTING OF FACTORY MOTORS

other locations three or four oil switches are mounted on a column near the group of motors controlled, no exposed wires being used, and all connections are made through condulets. Typical ceiling junction boxes are composed of a fuse board of $\frac{7}{8}$-in. soft pine, 10 in. by 12 in. in size, with junction box and condulet fittings, all 10 ft. or 12 ft. above the floor. The standard cage protecting motor oil switches mounted in a gang of eight is 6 ft. high, 4 ft. 2 in. wide and 16 in. deep, the switches being mounted on a wooden panel while the cage is provided with an angle-iron frame. All conduit in the plant is grounded, and the switch casings are grounded by a check nut on each side of the switch-box wall.

Throughout the plant all 550-volt conduit is painted a bright red.

Mounting of Oil Switches

In a typical column mounting of oil switches the latter are spaced 15 in. apart on centers vertically and include trip coils and condulets with conduit runs offset slightly to provide a symmetrical layout. In this case three switches control three 5-hp motors, each of which

Directions For Making Reports

Use Sharp 4H pencil. Submit all data called for. Use check mark for first three load columns, fraction for fourth column. In case of pumps give rating. Use as many sheets as necessary to prevent crowding, numbering each sheet DURING THE TEST. Report is to be made in duplicate; file carbon copy; send original to Engineering Department, being sure tests are numbered in order submitted.

Working Conditions, refer to starts under load, sparking at commutator, windings hot, bearings hot, etc.

Below make note of condition of motor and load during the test, such as rough commutator, loose connections, bearings dry or worn, or any other reasons explaining abnormal working conditions

FIG. 10—FORM OF REPORT CARD USED

drives seven screw machines of the automatic type. To serve groups of this kind at the end of a local feed, the line is dead-ended, if of the open type, on strain insulators attached by strap-irons to the ceiling beam, with taps on the line side of the insulators to a standard ceiling fuse block with porcelain barriers between phases, and conduit leading from the fuse block to the gang of switches. In another typical case where six 5-hp motors each drive a row of fourteen combination shavers and slotters the oil switches are mounted on a wall panel and are protected from accidental contact by a U-shaped railing at shoulder height, composed of $1\frac{1}{2}$-in. pipe. Sixteen wood-screw threaders are frequently driven by one 7.5-hp motor, and this size of motor drives eighteen shavers.

Record System

The company maintains a system of 3-in. by 5-in. index cards showing the size of motor, department and line-shaft location, with any test data which have been amassed as to the existing and rated load, shaft and motor speed data, pulley diameters, etc. This system enables the company to ascertain at a moment whether

10/13/14

5 HP. MOTOR DEPT. 6 LINE 7

WATTS, NO LOAD = 1000	
" FULL LOAD =	
" 15/14 " = 4750	
AMPS. FULL LOAD @ 80 P.F. = 6.0	MOTOR SPEED = 1745
RATED AMPS. = 5.2	SHAFT " = 460
OVERLOAD = 15%	" DIAM. =
CONDITION OF MOTOR =	PULLEY " = 15
	MOTOR PULLEY DIAM. = 4½
	SERIAL NO. 536195
TEST NOS. 71	R. & P. NO. X118

FIG. 11—TEST CARD OF 5-HP MOTOR

any particular motor is overloaded or not in case it is proposed to add machines in a given department section. In the typical card shown, the motor is overloaded by 15 per cent, and the friction load of the shafting is seen to be 1 kw, assuming 80 per cent power-factor. An effort is being made to list on each card the number of machines driven, so that the records will be complete for every motor. Thus, in the case cited, the motor

drives fourteen wood-screw shavers, although strict adherence to rating would limit this to twelve. The motor speed is 1745 r.p.m., by tachometer, and the shaft speed is 460 r.p.m. In another case a test showed that a 5-hp motor drove fifteen wood-screw shavers with a shaft speed of 486 r.p.m. The input was 8 kw, giving an overload of 92.5 per cent, and examination of the local conditions led to the substitution of a 7.5-hp motor, giving on further test an overload of only 23 per cent and a cool-running motor. Mechanical conditions in the line shafting and driven machines result in variable power demands.

Motor Applications

A few other examples of motor service are included. In Department 9 a 7.5-hp motor running at 1697 r.p.m. drives seventeen wood-screw threaders, the line-shaft speed being 636 r.p.m. The pulley diameters are 5.5 in. and 14 in. Here a 34 per cent overload is maintained, the no-load or friction input being 1250 watts and the full load 8750 watts, allowing for power-factor. In Department 6 there are twenty-three motors of 5-hp and 7.5-hp rating, driving wood-screw shavers, and in Department 7, where slotting is done, four motors rated at from 10 hp to 20 hp drive slotters, tumbling barrels, grinders and a small elevator. In the header room, Department 3, forty-six headers are driven by a 35-hp

TEST NO. _____ SHEET NO. _____ NO OF SHEETS _____

A. C. MOTOR TEST REPORT DATE _____

REED & PRINCE MFG. CO. WORCESTER, MASS.

DEPT. _____ BLDG _____ FLOOR _____ DRIVING _____ PULLEY _____

RATING _____ H. P. _____ AMPS. _____ VOLTS _____ TYPE _____ SERIAL NO. _____

R. & P. NO. _____ CIRCUIT NO. _____ LETTER _____ THIS MOTOR INSTALLED _____

INST. RATIO _____ TRANSF'R RATIO, SERIES _____ SHUNT _____

Inst. Reading			Computed			P. F.	R. P. M.	Start	No Ld	Ft Ld	Load	Working Conditions of Motor or Load
V. M.	A. M.	W. M.	Volts	Amps	Watts							

Countershaft Pulley _____ Speed _____ Tester _____

Width of Belt _____ See Also Tests Nos. _____

FIG. 12—TEST-REPORT CARD FOR MOTORS

motor, the total number of motors in the department being six and their combined rating 151 hp. In the cold-rolling and wire-drawing room a 100-hp motor drives three straightening machines, two wire blocks, three cold-rolling machines, two pointing machines, one emery wheel, one extractor, one washer, one drier, one magnetic separator, two riddles and a cutting-off machine. In this room also a drawing machine is geared to a 35-hp individual motor. In the annealing department a 1-hp motor drives a riddle and a 5-hp motor draws the pots out of the annealing furnace. Two electric furnaces are used in the forge shop, the all-day requirements averaging 7.7 kw per furnace, and all forges and furnaces are provided with electric pyrometers of Brown or Bristol type.

Motor test records are made in the field on cards like the sample reproduced, which are only 4 in. by 6 in. in dimensions, but which afford space for all essential engineering data, instrument and speed readings, and deductions as to the fitness of the motor for a given service. To facilitate testing motors rapidly, the master mechanic of the plant, Mr. L. H. Carter, has designed a portable table, 26 in. long, 17 in. wide and 33 in. high, which contains a top shelf for an indicating wattmeter, a short-circuiting switch for the instrument, permanent connections, and binding posts to which flexible leads of No. 0 wire about 16 ft. long may be attached when run to the motor fuse block or switch terminals. Series transformers are carried on a lower shelf, and the connections of the apparatus provide for quickly taking the power consumption readings on any motor within the range of the equipment. In normal operation, when the apparatus is connected in circuit, the wattmeter is cut into two phases of the motor service, either directly or through the series transformers, and a connection is also made across either phase to the potential coil of the wattmeter. When using the series transformers the potential connection is made directly across the motor fuses or switch terminals, in order to avoid the drop in the transformers.

Costs of Extensions

The relation of costs of line extensions and transformers to probable revenues from customers who wanted service justified the Railroad Commission of California in deciding in a recent case that it was unfair to expect the company to extend service entirely at its own expense. The case affected the Pacific Gas & Electric Company. The commission outlined an apportionment of the expense and directed the company to extend its portion of such service, provided that a share of the cost was met by those who wanted service.

Messrs. Charles E. Warren and Herbert Pash complained that the company refused to supply service unless they advanced respectively $900 and $629.10. The payments were to be refunded in annual instalments on the basis of 20 per cent of the payments made by the consumers to the company during the year. Mr. Warren desired service for light and a small motor for domestic pumping at his residence and for a 20-hp motor for irrigation pumping. Mr. Pash, in addition to lights in his residence and other buildings, desired service for a 20-hp motor to be used for irrigation pumping purposes in two locations at different times of the year.

Mr. L. S. Ready, assistant electrical engineer of the commission, recommended that the consumers construct at their expense lines situated entirely upon their properties, and that the company construct at its expense lines on public highways in addition to furnishing and installing necessary transformers and meters. This suggestion was accepted by the company but the complainants wanted a formal ruling by the commission. The company estimate of cost was: Extension of 11,000-volt line, 0.9 mile, $629.10; tap lines for Warren residence, 300 ft., $58.50; for Warren motor service, 2500 ft., $258.30; for Pash residence, 500 ft., $55.30; total, $372.10. Transformers and meters were estimated as follows: Warren residence, $17.25; Warren motor service, $241.95; Pash residence, $6.50; Pash motor service, $300.40; total, $566.10. This indicates a total estimated cost of $1,567.30. Annual revenue was estimated by the company as follows: Warren residence, $42, and motor service, $120; a total of $162; Pash residence, $12, and motor service, $120; a total of $132 and a grand total of $294.

Mr. Ready estimated costs to the company as follows: Main extension, $599.70; transformers and meters, $562.90; transformer switches, $40; secondary extension along road, $105.70; labor of installing transformers, transformer switches and meters, $78.50; total, $1,386.80. The commission estimated costs of the extensions across private property thus: To Warren 20-hp pump, $210.60; to Warren residence, $28.60; to Pash residence, $52.00; total, $291.20. The estimate by Mr. Ready of probable annual revenue was: Warren residence, $48; Warren motor service, $120; Pash residence, $15; Pash motor service, $180; total annual revenue, $363.

Distribution of Energy in a Flour Mill

The power required to operate a flour mill is divided among the various mill operations approximately as follows, according to the superintendent of a large Minneapolis milling company: Wheat-cleaning operations, 35 per cent; break-rolls and middling rolls, 15 per cent; smooth rolls, 25 per cent; bolting and purifying operations, 25 per cent.

An average 1000-hp mill having an output of 3500 to 4000 barrels of flour per day will show an energy consumption of from 6 kw-hr. to 10 kw-hr. per barrel.

Motor Drive in Marble Works

When a manufacturer who has been driving his machinery for years with waste steam costing practically nothing can become enthusiastic over the results obtained with motor drive, it shows that electric service has many advantages even when other forms of energy can be obtained at ridiculously low prices. Such was the case with Alexander Pelli & Company, who operate marble works in New York City. Formerly this company's plant was situated next to a laundry from which steam for operating the machinery was obtained for a song. Wishing to expand their business, the manufacturers moved to more commodious quarters and seriously contemplated installing a producer plant for operating gas-engine-driven machinery. However, after being shown how central-station service and motor drive would economize space and afford more flexible and reliable operation they installed polyphase Wagner motors. These machines had the advantage of not requiring the attention which commutator motors would probably need where marble dust is present in the atmosphere. Twelve motors were installed having a total rating of 103 hp. Their distribution is indicated in the accompanying table. Records show that the average monthly energy consumption has been 4388 kw-hr., making the average monthly consumption per connected hp 42.5 kw-hr. Energy is used 192 hours a month at an average cost of about 0.54 cent per kw-hr. Electric service is furnished by the United Electric Light & Power Company.

FIG. 1—CARBORUNDUM STONE OPERATED BY 25-HP MOTOR

FIG. 2—RUBBING BED DRIVEN BY COMPENSATED MOTOR

DISTRIBUTION OF MOTORS

Motor Data			Transmission	Machine Driven
Hp	Type	R.P.M.		
25	Slip-ring	1140	Belt	Carborundum stone
10	Compensated	850	Belt to shaft	Patch 13-ft. rubbing bed
30	Slip-ring	1200	Belt	Hewes & Phillips carborundum machine
5	Squirrel-cage	1140	Belt to countershaft	Patch 7-ft. 8-in. polishing machine
5	Squirrel-cage	1140	Belt	12 ft. x 2.5 ft. planer
3	Squirrel-cage	1140	Belt	Whitcomb No. 2 planer
3	Squirrel-cage	1140	Belt to countershaft	13.5-in. lathe. Small drill press
3	Squirrel-cage	1140	Belt	Two-spindle emery wheel. 6 in. x 1 in. and 10 in. x 0.375 in.
3	Squirrel-cage	900	Belt to countershaft	150-ft. wire saw.
10	Slip-ring	900	Belt	65-lb. air compressor
3	Squirrel-cage	1140	Belt	10-in. circular wood saw
3	Squirrel-cage	1140	Belt	Small centrifugal water pump

Life Record for Transformer Oil

One central station in the Mississippi Valley used four arc-lamp tubs eighteen years, moved them from one power house to another, and never changed or cleaned the oil in them. At the end of that time the engineer began, he said, "to mistrust the oil," so a small filter press was purchased and the oil was taken from the tanks. When the oil had been drawn off it was discovered that there was approximately 3 in. of "muck" in the bottom of each tank. This residue was taken out, the tubs were given a thorough cleaning, the oil was filtered and replaced in the tubs. Then the transformers were again used on arc-lamp circuits where they operated successfully for several months. The same set of units is now supplying energy to a gas-filled tungsten-lamp installation, and the same oil that has been in the tanks for eighteen years is being used.

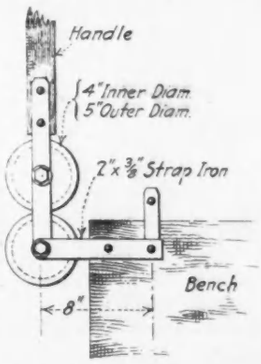
Interpole Railway-Type Motors Operate Large Lift Bridge

A lift bridge recently installed across the Chicago River has a span of 272 ft. 10 in. between towers. Bridging this gap is a lift span which weighs 2,623,000 lb. and which can be raised the distance of 111 ft. from its normal position to its maximum height in forty-five seconds. The electric motor which moves this huge steel structure and its massive 196,000-lb. concrete and steel counterweights is a 300-hp, 220-volt Westinghouse interpole, railway-type machine. To insure continuity of service duplicate motors are installed. Energy is supplied from the lines of the Commonwealth Edison Company.

Operating Kinks

Device for Bending Conduit and Pipe

The sketch herewith shows a simple and inexpensive but useful device for bending conduit and pipe 0.75 in. to 0.50 in. in diameter. The metal pieces are of strap-iron 2 in. wide and 0.375 in. thick. The grooved wheels are identical in shape, each measuring 4 in.



BENCH DEVICE FOR BENDING PIPE

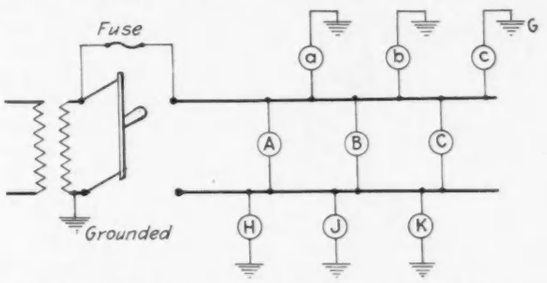
in inner diameter and 5 in. over the flanges. At a distance 8 in. from the center of the wheels a bridge is mounted on the bench to hold the pipe which is being bent. With the aid of the extended handle, powerful leverage is brought to bear on the conduit and smooth bends can be made of any radius larger than that of the grooved wheels.

Independent Operation of Special Lamps from Main Lighting Circuit

In shops and stations where "juice is cheap" the cost of lamp renewals often becomes excessive because whole circuits, or even all the lamps in the building, may be turned on while using a single extension light.

This difficulty may be avoided, of course, by the use of separate circuits and special outlets, but such an arrangement is open to the objection of cost of wiring and the fact that changing conditions may require frequent alterations.

If, however, one side of the system is or may be grounded, certain outlets may be left "alive" when the main switch is open by means of the connections shown in the accompanying diagram. Here *A*, *B* and *C* repre-



CONNECTIONS FOR OPERATING SPECIAL LAMPS

sent the principal lamps and *a*, *b* and *c* special outlets. It will be noted that the "live" side of the switch is "jumped" through a fuse, and that the special outlets are connected from the resulting live leg of the circuit to ground. If the special outlets are used for extension lamps, it will be a great convenience to use a light fuse in the jumper. This precaution centralizes any "fireworks" caused by defective extension cords.

Certain lamps, on the other hand, may not be needed when the principal lamps are in use. If the total wattage of such lamps *H*, *J* and *K* is small as compared with that of the "main" circuits, they will burn brightly in series with the main lamp group, but will be extinguished automatically when the switch is closed to light the main circuit. It will be noted that the group *A*, *B*, *C* is in series with the group *H*, *J*, *K* when the main switch is open.

The connections above described are used in the power house of the Mohawk Hydro-Electric Company at Ephratah, N. Y. Outlets *a*, *b*, *c*, etc., are used for extension cords, desk lamp, oil vault, etc. Lamps *A*, *B*, *C*, etc., are 400-watt main lamps suspended from the roof. Lamps *H*, *J*, *K*, etc., are an equal number of 25-watt gage lights which are needed only when the 400-watt lamps are off.

The Evolution of an Old Hand-Power Fire Engine

The sturdy red running gear which used to carry the hand-pumped, citizen-propelled fire engine of the city of Crawfordsville, Ind., on its wild dashes at the heels of an excited volunteer company has in its declining years taken up a less heroic although probably more profitable vocation. As may be seen from the accompanying illustration, this ancient piece of fire-fighting equipment, now dismantled and replaced by

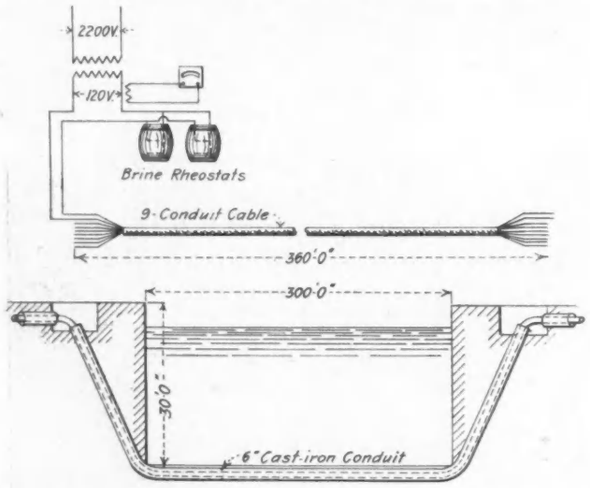
CRAWFORDSVILLE'S OLD FIRE TRUCK NOW A PORTABLE SUBSTATION

a modern outfit, is serving as a conveyance for a permanently rigged but portable transformer station. Over the rear axle two 25-kw transformers have been placed and the primary taps brought out are permanently connected through fuse plugs to long insulated leads which lie coiled in the wagon bed when the outfit is not in use. The secondary leads, carefully insulated and fastened to the upright frame, are run through knife-blade switches and arranged for ready connection to incoming lines, which may be dead-ended on the substantially mounted cross-arm above the transformer bank. Connections to the knife-blade switches are arranged so that either one or both of the 25-kw transformers may be used to give 110/220 volts on the secondary winding. All connections are clearly labeled to avoid possibility of mistake, and a row of lamps along the lower cross-arm illuminates the portable station at night, both for the benefit of the linemen who may need to work on the transformers and for the safety of pedestrians who might collide with the live wires in the night. At county-fair time, when "chautauquas" are held at the fair grounds and at

times when a transformer burn-out creates an immediate need for service, this truck is hastily taken to the scene and connected to a primary circuit to render the emergency secondary service.

Drying Out Cable with Electricity

After pulling 360 ft. of two-conductor, lead-covered cable through a cast-iron conduit under a ship canal, it was found that the conductors had become grounded by water which apparently had entered through the sealed end. Sawing off sections at the end did not eliminate the "ground," so electricity was resorted to to dry out the insulation. One terminal of low-voltage winding of a 30-kva, 2200/120-volt, single-phase transformer was connected with two parallel-connected brine rheostats, and the circuit completed through two of the cable conductors joined at the opposite end. Connected in the circuit were also an ammeter and a Thompson "megger." A current of 205 amp was maintained for 210 hours at 120 volts, making the energy consumption 5166 kw-hr. Possibly a more uniform removal of



METHOD OF DRYING CABLE INSULATION ELECTRICALLY

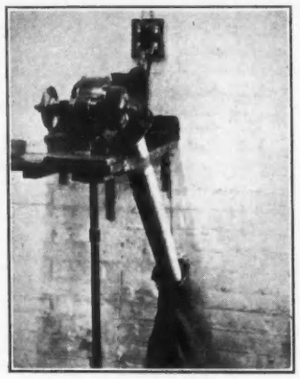
moisture could have been obtained with a smaller current had all of the cable conductors been connected in series, although this arrangement would have interposed higher potential differences between conductors.

Rapid Service Restoration Made Possible by Substation Design

Much of the credit for shortening the duration of what might have been a serious service interruption on one of the lines of the Commonwealth Edison Company, Chicago, April 23, is due to the company's standard practice in distribution-line construction. In this instance an arc started by the switching of a compensator in the Grove Street substation greatly damaged the station switchboard. Outside the substation, however, the circuits were equipped with G. & W. potheads installed on the poles and on the underground lines, so that in emergencies the permanent connections could be easily broken and connection completed to adjacent circuits without the necessity of making any served or bolted joints. For the trouble-man to restore service after the arc had been extinguished was, therefore, a short task. The pothead switches on leads going into and coming from the station were simply disconnected and pothead terminals were changed to bridge the gap left by the disabled leads.

Home-Made Dust Collector for Buffing Wheel

Elimination of the dust nuisance which usually accompanies the buffing of meter casings and other light apparatus has been accomplished in the laboratory of the United Electric Light Company, Springfield, Mass., by the home-made equipment illustrated herewith. The buffing wheel, which is belt-driven by a 0.5-hp motor, is

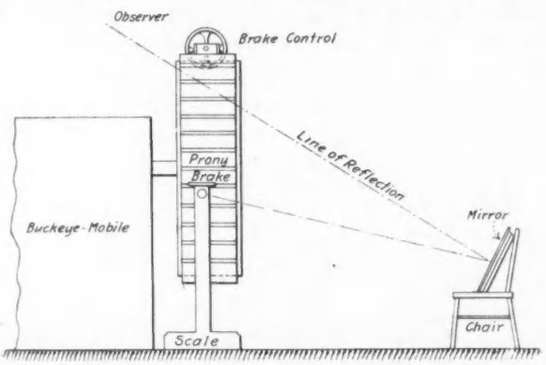


HOME-MADE DUST COLLECTOR FOR BUFFING WHEEL

partly inclosed in a galvanized-iron hood which discharges into an inclined pipe of the same material measuring 3 in. in diameter and 30 in. long. The lower end of this pipe terminates in a gunny-sack attached by a short piece of wire to the table supporting the motor and polishing equipment. Although the motor runs at 1725 r.p.m. and the buffing wheel makes substantially the same speed, the dust ground off the stock is automatically delivered into the bag instead of being scattered about the premises. The advantage derived both in the matter of workshop tidiness and in the enhanced comfort of the operator is obvious.

Mirror Helps in Engine Testing

An ingenious mechanic in the shops of the Buckeye Engine Company at Salem, Ohio, has contrived to use a mirror to aid him in his daily work. It enables him to watch the scale beam which tells him whether or not he is holding the brake load on the engine constant while the unit is under test. Owing to the manner in



LOOKING GLASS USED BY ENGINE TESTER IN WATCHING THE SCALE BEAM

which the prony-brake rigging is arranged on the test floor, the man who controls the brake pressure has to sit well up above the top of the flywheel and almost directly over the scale. By setting the mirror on a chair at the proper distance from the scale the reflected image of the scale beam is always within the brake tender's vision.

Extracts and Abstracts

Alternating and Direct-Current Control Problems in Steel Mills

Under the auspices of the industrial power committee, the convention of the American Institute of Electrical Engineers held at Pittsburgh in April devoted particular attention to the subject of direct-current and alternating-current operation and control in steel mills and iron works.

Alternating-Current Control Features

In his paper on "Alternating-Current Controllers for Steel Mills," Mr. Arthur Simon pointed out that the squirrel-cage motor, on account of its simplicity and stanchness and the absence of collectors, is the most desirable machine for steel-mill service. The slip-ring-type motor does not have the disadvantages of the squirrel-cage type, but requires collectors, which are the cause of frequent trouble. The question of control must also take into consideration such purely commercial points as the relative advantages of low first cost, energy consumption, labor and attendance, and renewals. The simplest and earliest forms of controllers were of the face-plate type, a modification of which is the multiple-lever type which is particularly suitable for large ratings. The advantage of this type is that the starting resistance cannot be cut out too suddenly.

There are two methods of operating automatic controllers with current-limiting relays—one by putting relays in the primary circuit, and the other by putting relays in the secondary circuit. The primary relay must be designed for continuous service, which makes it rather bulky and sluggish. The secondary relay need be arranged for very intermittent duty only, making it correspondingly light and sensitive. A type of controller which finds frequent application in steel-mill practice is the reversible automatic controller. This mechanism is used for intermittent service requiring frequent starting and speed regulation at all controller points.

Alternating-Current Hoisting Problems

Mr. Raymond E. Brown read a paper on "The Alternating-Current Coal Hoist." The coal hoist presents a different problem in several respects from those involved in most other machines used for hoisting materials, because (1) an accurate analysis of the cycle of operation must be had in order to obtain a motor of proper speed, torque and heating capacity, (2) the electrical equipment must be capable of continuous operation at the maximum speed permitted by the weight lifted, the motor characteristics and operator's movements, and (3) heavy unbalanced loads are lowered at high speeds and yet under very exact control. The friction brake control, manually operated, must make a complete stop before reaching the bottom in order to prevent the rapidly moving heavy bucket from damaging barges or steamers on landing. This causes an appreciable loss of time which can be entirely avoided when dynamic braking is used.

A further advantage that is inherent in dynamic braking is that the heating capacity of the motors can be more accurately determined than is possible with the ordinary friction brake. Although the maximum lowering speed is greater than the hoisting speed with dynamic braking, the bucket reaches its destination with a shock that is barely perceptible. Furthermore, the handle may safely be thrown over to maximum braking when the bucket is descending at maximum speed.

Direct-Current Control in Steel Mills

Mr. H. F. Stratton opened the afternoon session with a paper on "Mill Controllers." In almost any type of mill controller the main object is to start, stop or reverse the machine and its load in the quickest feasible time, the work done at constant speed being of minor importance. Mr. Stratton's paper was, therefore, devoted to an analysis of the acceleration of a motor-driven machine. In the complete acceleration of a machine driven by a series or compound-wound motor, there are two stages through which motor and machine must pass before they attain a situation of even instantaneous stability. The first stage begins when the armature and the starting resistance are connected to the supply lines and ends when the starting resistance has been completely short-circuited and the armature is receiving full line voltage. The second stage begins when full line voltage is applied to the armature and ends when the developed motor torque equals the torque of the work load. The paper closed with an analysis of the effect of the ratio of gearing between motor and machine, and a determination of values of this ratio to give the quickest starting and stopping.

For quickest starting from rest and making any number of revolutions, the ratio of gearing, r, is determined by the formula:

$$r = \sqrt{\frac{I_1}{I_2} + \left(\frac{F}{T}\right)^2} + \frac{F}{T}$$

where I_1 is the moment of inertia of machine and I_2 is that of the armature, F is the load torque of the machine, and T is the mean torque developed by the motor in pound-feet. If quickest stopping from any speed of rotation is desired, the last expression $\frac{F}{T}$ should be given a negative sign.

From the Operator's Viewpoint

Mr. J. S. Riggs followed with a paper describing electrical control problems peculiar to steel-mill service viewed from the standpoint of the operator. No provision for emergencies can be made, since any delay or interruption in the cycle of operations means scrapping of material and loss of time. Equipment must therefore be as nearly fool-proof as possible. The advantages of the magnetic controller, which the author enumerated, make it in his opinion the best for the service. The control for the equipment of a loom mill and a rolling mill can be standardized in four distinct constructions, viz.: (1) full reverse, single-speed type, (2) full reverse, multi-speed type, (3) full reverse, multi-speed type, dynamic braking, and (4) non-reverse, push-button type. The apparatus required with each and the equipment with which each is used are enumerated. The only way absolutely to protect the equipment against short-circuits and overloads, the author stated, is to install two relays, one in each side of the line, and also a contactor in that side of the line which feeds the motor field winding. It was recommended that as few different sizes of motors be adopted throughout the mill as possible.

Discussion

Mr. T. E. Tynes put in a plea for standardization. There is a great expense attendant upon keeping the repair parts for so many different types of motors as are now in use. It means tying up of a considerable amount of capital.

Mr. K. A. Pauly stated that in induction motors alone, considering only sizes from 1 hp to 200 hp inclusive, there are frequently fifteen different ratings which must be designed for five different voltages—

110, 220, 440, 550 and 2200—making 75 in all; that there are three frequencies—25, 40 and 60 cycles—further increasing the number to 225; that the number of principal speeds will average four, making a total of 900, and that, finally, considering subdivisions of types of apparatus, the total will be brought up to about 1500.

Mr. Graham Bright stated that as fast as the manufacturers bring out a motor which will meet a certain set of conditions the steel-mill operators bring out a new set of conditions which are more severe in many cases, thereby making it necessary for the manufacturers immediately to bring out a new motor. The conditions of lack of standardization are caused by the advance in the art on both sides, which will probably continue for some time.

Fire Protection in Electric Plants

In a paper read before the Boston Society of Civil Engineers Mr. Nathan H. Daniels, head of the statistics department, Stone & Webster, Boston, emphasized the wide range of hazards existing even in a single group of stations, depending upon construction and operating conditions. Under the latest schedule a fireproof station of standard construction and occupancy takes a base rate of 7 cents per $100 of insurance for building and non-electrical contents and 12 cents for electrical contents. If the building should have unprotected metal columns supporting roof or floors, 1 cent is added to the above figures; if wooden skylights, 2 cents for the first and 1 cent for each additional, with a maximum charge of 7 cents; if joisted wood floors, 10 cents; if combustible finish leaving concealed space in walls, 3 cents; if oil transformers unless in fireproof rooms, 3 cents; if lightning arresters are not standard, 2 cents; if wooden lockers, 2 cents; if gasoline is stored in the building, 15 cents; and if a fire hydrant is over 500 ft. distant, 5 cents, with an exposure charge depending on the relation of the structure to other buildings. Although a standard building takes the 7-cent rate, a frame shingle-roofed building with unprotected openings to the basement, defective switchboard and wiring, careless operation and no fire protection might take a rate of from $2.50 to $3, or forty times the rate on the standard station. From the standpoint of the public utility company, on a million-dollar station each additional 10 cents in the insurance rate means $1,000 annually in insurance premium, or 5 per cent interest on an investment of $20,000. More serious yet is the hazard of interrupted service.

Mr. Daniels advocated the use of labeled protective apparatus in the line of fire doors, extinguishers, fusible links, hose racks, fire-retarding paint, etc., pointing out the difficulties and time required for even an engineer to determine whether all details of manufacture are standard. Discussing specific protective problems, he emphasized the importance of avoiding the storage of wooden blocking on roof trusses and the careless disposal of waste excelsior and packing cases during and after the construction period in generating plants and substations. Joints in temporary wiring need special attention. Fireproof doors in stair towers are sometimes omitted, and the storage of combustible materials in power station basements is a common oversight. A low insurance rate on a station addition was secured by replacing the wooden floor of the original plant by concrete, the two sections being necessarily interconnected with openings, for operating reasons. In generating plants divided into two sections with a fire wall between the boiler room and the turbine room, and with a basement common to both in part, great care should be taken to avoid exposing the columns between the two sections to fire, in view of the liability of roof destruction in case of a basement blaze. Sketches of a station design submitted early to the insurance authorities save time and trouble and enable the best protective measures to be taken at the lowest practicable outlay.

Boiler-Room Losses and Their Prevention

As the amount of coal sifting through the grates with the ashes usually appears larger than it really is, many engineers try to reduce the loss by making the air spaces in the grates smaller. The advantage gained, however, is usually offset by the increased chimney loss, especially if the coal contains fusible ash which is liable to produce sticky clinkers, according to the Bureau of Mines. If the ashes accumulate on the grate, the fires must be cleaned more frequently, consequently more air enters through the furnace doors and allows more heat to escape through the chimney. Sifting of coal through the grate can be prevented by not placing fine coal on the bare grate, which means that no holes should be allowed to form in the fuel bed. If thin spots do occur, they should be covered either with burning coal or with a shovelful of fresh coarse coal.

One of the greatest losses in the boiler room is through the smokestack, but it is possible to reduce this loss. Each pound of air absorbs approximately one-fourth of a heat unit for each degree of temperature rise. Therefore, if 31 lb. of air is used to burn 1 lb. of carbon and the temperature of the gas leaving the uptake is 500 deg., about 4000 lb.-Fahr. units will be carried away instead of 2000 units when only 15 lb. of air is used to burn the carbon. The temperature of the flue gases can be kept low by frequently cleaning the boiler tubes inside and out. Preventing leaks through the boiler setting and holes in the fuel bed will also reduce losses. Other leaks may be found around the furnace-door frame and in the smoke uptake, the total air leakage sometimes amounting to 25 per cent of the gases passing through the uptake.

Moisture in the coal or in the air supporting combustion also produces a loss by carrying away heat through the chimney. The loss averages about 4 per cent and increases at the rate of about 1 per cent for every 10 per cent of free moisture present.

In a plant having large boilers operating at full rating and where the boiler and piping are well insulated the radiation loss may be as low as 2 or 3 per cent. In a plant containing small units operating below rating, and where parts exposed to radiation are not well insulated, the loss may be as large as 10 per cent.

Preventing Corrosion of Steel

As large amounts of steel are employed in electric-service plants and in transmission lines, particular attention should be paid to the prevention of rusting. According to an article in a recent issue of the *Valve World*, basic paints, or those containing a chromate pigment, are the best for protective purposes. However, many basic pigments, such as basic lead carbonate or zinc oxide, do not withstand weather. Therefore to obtain the most substantial covering a basic priming coat should be applied and then coated with a mixture of a basic pigment and a little lampblack. When this is dried it should be covered with a lampblack or graphite finishing coat. The latter makes a very impervious and highly resistant paint film. The common practice of clean-wiping galvanized pieces should be discontinued as a layer of zinc-iron alloy is formed, which is not so durable as a uniform substantial coating of spelter.

Questions and Answers

Specific Heat of Coal Ashes

What is the specific heat of coal ashes? J. P. L.

About 0.16, according to one authority.

Permanent Gas

What is meant by a permanent gas? C. O. F.

A permanent gas is a body that remains in a gaseous state at ordinary temperatures. Atmospheric air is a permanent gas; other permanent gases are oxygen, hydrogen, nitrogen, carbon dioxide and ammonia.

Proportion of Plant Expenses Due to Fuel

What percentage of the total running expenses of a steam plant does the cost of fuel represent? A. M. B.

It varies according to the size and nature of the plant and the quality of fuel, but under ordinary conditions the fuel bill represents from one-third to two-thirds of the cost of operation.

Fatigue of Metals

Please explain what is meant by fatigue of metals. B. W.

If a piece of metal, such as a machine part, is subjected to repeated stresses of like nature, the strength of the piece decreases. This weakening of the metal, which is usually accompanied by a crystallization of the structure, is commonly termed fatigue.

Semi-Diesel Type of Engine

What is the principle of the semi-Diesel engine that I have seen referred to in various papers? J. A. F.

The semi-Diesel engine uses low compression as compared with the Diesel type, the compression pressure being in the neighborhood of 180 lb. per sq. in. The charge is not ignited by the heat of compression, therefore, as in the Diesel, but by a hot bulb into which the oil is pumped.

Bags in Boiler Shells

What causes the formation of bags in boilers? L. F.

A bag in a steam boiler is due primarily to overheating of the shell at the point where the bag occurs. Through the introduction of oil into the boiler, or the lack of care in cleaning, sediment or scale accumulates on the water side of the plate. The heat is thus prevented from passing into the water and the plate becomes highly heated. In this condition the material is softer and weaker than when cold, and the internal steam pressure forces it outward, forming a bulge. It is called a bag because it commonly occurs on the bottom sheets of return-tubular boilers.

Burning Mixed Anthracite and Bituminous Coal

In the plant where I am employed as fireman shaking grates have been installed to burn unwashed culm, better known here as hard-coal screenings. The results so far have been unsatisfactory. We have been using about 30 per cent of soft coal mixed with the screenings, but the mixture has a tendency to coke and prevent the circulation of air through the fuel bed. Using the slice bar under such conditions only adds to the trouble. Can you suggest a remedy? R. C.

The tendency to coke is doubtless due to the high percentage of bituminous coal used. In comparison with other plants burning mixed coals of these kinds, you appear to be using two or three times the usual proportion of soft coal. From 10 to 15 per cent of bituminous coal is the usual practice.

Protecting Lamps on Three-Wire Systems

We employ balancer sets to maintain the neutral point on a three-wire direct system. When overloads occur on either side of the neutral, however, the voltage on the opposite side increases enough to burn out the lamps connected thereto. What simple apparatus can be employed to prevent this? D. A. S.

The protection desired can be obtained by connecting a differentially wound relay across the two sides of the system and wiring the relay contacts in series with the trip coils of the main circuit-breaker. The relay may be set so that when the voltages are unbalanced by a predetermined amount the circuit-breaker will be opened, thereby preventing injury to lamps from overvoltage.

Proximate and Ultimate Analyses of Coal

What is the exact difference between the proximate analysis and the ultimate analysis of coal? A. J. B.

The proximate analysis of coal is made to determine merely the percentages of moisture, ash, volatile matter and fixed carbon. In the ultimate analysis, on the other hand, the coal is resolved into the chemical elements that compose it and the percentages of those elements, such as carbon, hydrogen, oxygen, nitrogen and sulphur, are stated. For example, the proximate and ultimate analyses of a certain coal are, in percentages, as follows: Proximate analysis—Moisture, 5.26; volatile matter, 14.71; fixed carbon, 55.22; ash, 24.81. Ultimate analysis—Carbon, 59.87; hydrogen, 3.91; oxygen, 9.18; sulphur, 1.00; nitrogen, 1.23; ash, 24.81.

Suspending Zinc Slabs in Boilers to Prevent Scale

Is it possible to prevent the formation of scale in steam boilers by suspending zinc slabs in the water space? M. V. McB.

It is extremely doubtful whether the suspension of zinc slabs in a boiler will prevent scale. Scale is due to the presence in the feed water of substances like the sulphates and carbonates of lime and magnesia. When the water is heated, these substances are precipitated and are baked on the plates and tubes. The action of zinc in a boiler is galvanic and is intended primarily to prevent corrosion of the metal parts of the boiler. To prevent scale formation it would have to change the nature of the sulphates and carbonates or else keep them from coming in contact with the boiler, neither of which it is able to do. It is true that in the course of the galvanic action set up by the use of zinc hydrogen is set free at the water surface of the plates and tubes, and the liberation of hydrogen in this way, if rapid enough, might prevent scale from adhering; but it is scarcely to be believed that the feeble galvanic action set up by the use of zinc slabs could produce hydrogen at a sufficient rate to keep all sediment and precipitates from collecting on the surfaces of the metal.

Steadying the Voltage on Automobile Lamps

The rapidly changing engine speed on our Ford trouble car causes the light from the headlamps operating from the magneto to fluctuate badly. Can this trouble be remedied? A. F. D.

The trouble can be remedied by inserting an external reactance in the magneto circuit. The inserted reactance will reduce the available potential somewhat and necessitate the use of lamps of a lower voltage rating, but the light from them will be of sufficient intensity and will be steady. One lamp manufacturer has taken the trouble to test carefully a Ford motor and has calculated the correct amount of reactance to insert in the magneto circuit to produce stable voltage conditions. Engineers of the lamp company after checking the calculations, building a reactor and demonstrating the

feasibility of their scheme offered the results of the test to the engineers of the motor-car factory, pointing out at the same time slight changes in magneto design which would improve it as a car-lighting unit. The suggestions proposed the addition of a few turns to the magneto coils to increase the voltage and the insertion of external reactance to steady the voltage.

Total Cost per Kilowatt and Unit Cost of Energy Production

How do total costs and unit costs of producing energy vary with different load-factors in stations equipped with reciprocating engines, gas engines, waterwheels, steam turbines and combinations thereof? S. H. H.

The average annual cost per kilowatt installed depends on the annual load-factor and the fixed charges, which in turn depend upon the size of the plant. In a hydroelectric transmission system the total cost per kilowatt increases only slightly with increase in load-factor, as the fixed charge is a large proportion of the total production cost. In plants equipped with other prime movers and not involving long transmission distances the cost increases more with increase in load-factor, being most rapid with reciprocating engines and gradually less so with steam turbines, reciprocating engines and turbines, gas engines, and gas engines and turbines. If the equipments named were idle throughout the entire year, the annual costs per kilowatt installed for a fair-sized plant might be assumed to be about $15 with reciprocating engines, $12 with turbines, $13 with reciprocating engines and turbines, $17 with gas engines, $15 with gas engines and turbines, and $14 with hydraulic equipment. The annual costs per kilowatt when operating at 100 per cent load-factor would be respectively $52, $38, $38, $37, $32 and $16. Between zero load-factor and 100 per cent load-factor the total cost per kilowatt installed increases at a uniform rate, and hence straight lines can be plotted for each equipment and the average costs per kilowatt-hour can be computed therefrom by dividing the ordinates by 8760 times the corresponding load-factor. The above figures have been based on coal containing 11,000 lb.-Fahr. heat units per lb. and costing $1.50 per ton.

Relative Characteristics of Sixty-Cycle and Twenty-five-Cycle Apparatus

How do twenty-five-cycle and sixty-cycle generators, transformers and rotary converters compare as to reliability, efficiency and price? T. T.

Not considering long-distance hydroelectric transmission installations, sixty-cycle apparatus in general is reliable, in some cases slightly more efficient than twenty-five-cycle apparatus, and sometimes less expensive. With high-speed sixty-cycle generators operating in conjunction with inadequate transmission systems the regulation is not quite so reliable under extreme load fluctuations as with twenty-five-cycle units. Twenty-five-cycle generators are from 15 to 35 per cent more expensive than sixty-cycle machines of the same rating. Transformers designed for the lower frequency are from 25 to 50 per cent more expensive than either air-cooled or oil-cooled sixty-cycle units of the same rating. Rotary converters designed for sixty cycles are more liable to hunt and flash than twenty-five-cycle machines and are therefore not quite so reliable. Considering combined rotary converter and transformer equipment, the sixty-cycle apparatus is slightly more efficient than twenty-five-cycle apparatus at overloads and about 1 per cent less efficient at 75 per cent rated load. Moderate and small sizes of equipment designed for sixty cycles are from 10 to 15 per cent cheaper than that operating on the lower frequency.

Care of Transformers

What attention should be given to a transformer to insure long and continuous service? H. A. S.

To keep transformers in perfect operating condition care should be taken to allow no moisture to come in contact with the insulation, to prevent overheating, and to guard against current or voltage surges. Assuming that protection against the latter has been provided by auxiliary equipment, only methods of attending to the transformer itself will be considered. Moisture may get into the insulating material during transportation to the place of installation or may be absorbed during operation through leaks in the case or from the cooling medium. As now shipped, transformers should arrive at their destination without absorbing moisture. If a slight amount of moisture has been absorbed, it can usually be removed by passing a low-voltage direct current through the windings for several hours to heat them, meanwhile maintaining a vacuum to draw off the water vapor. If there is danger of breaking down the insulation, the windings may be immersed in a bath of oil heated by some external means and subjected to a vacuum. If the transformer is oil-cooled, samples of the oil should be drawn from the bottom of the case and tested before the unit is placed in operation. Good oil should not break down at any emf below 30,000 volts, which corresponds to the pressure required to cause a spark across a gap between ball-tipped rods 150 mils apart. If the oil is drawn off, the transformer should be carefully protected from moisture and foreign particles by covering and maintaining a low humidity. Oil for filling transformers should be forced through a filter press to remove moisture and suspended particles. When a filter is not available, dirt may be removed by passing the oil through several thicknesses of bolting cloth. Moisture may be removed in a fairly satisfactory way by passing hot air through the oil, heating it in a vacuum, or by placing bags of dry lime in the oil before filtering. A simple method of drying and cleaning oil without de-energizing the transformer is to connect a filter press with the bottom and top of the tank so that as fast as oil is removed from the bottom an equal amount is added at the top. Unless the oil is kept clean, sediment may form on the radiating surfaces and the transformer will overheat owing to the poor conduction of the deposit. Dust and dirt can be prevented from entering the case if every opening is carefully sealed and all joints are fitted with gaskets. After a transformer has been put in operation it should be inspected about every six months by testing oil drawn from the bottom of the tank and examining the condition of the radiating surfaces. As good transformer oil is fairly transparent, it need not be drawn off for this examination. Instead, a lamp bulb can be lowered into the tank and the surfaces inspected from above. If slime or dirt has accumulated on the coils, the interior of the case or the water coils (if the unit is water-cooled), the oil should be drawn off, the deposit removed, and the surfaces wiped with dry, clean waste. Ventilating ducts can be cleaned by squirting dry oil through them and scale-lined water tubes can be cleared with a solution of hydrochloric acid. Most insulation will not withstand prolonged heating much above 100 deg. C. without permanent injury, but it is practically impossible to determine the temperature of the hottest parts of a transformer. In general, the temperature drops from windings to oil and from oil to cooling medium are 10 deg. and 30 deg. C. respectively at full load and 15.5 deg. and 38.5 deg. respectively at 125 per cent load. By observing the temperature of the cooling medium the approximate temperature of the winding can therefore be estimated.

COMMERCIAL SECTION

MAPPING THE MOTOR OPPORTUNITY

How a Census of Prospective Motor Users Has Been Applied in Brooklyn and New Jersey

Two of the large Eastern central stations, the Edison Electric Illuminating Company of Brooklyn and the Public Service Electric Company of New Jersey, have recently compiled, in the form of a complete census of prospective users of motor service, an exceedingly interesting demonstration of their energy markets. Both companies followed the same general plan and system. This embraces a map on which are marked all motor users not already connected to the company's lines and a card file of complete information on the conditions obtaining in each case. The plan as carried out is a striking illustration of the stimulative influence that the graphic presentation of any opportunity exerts.

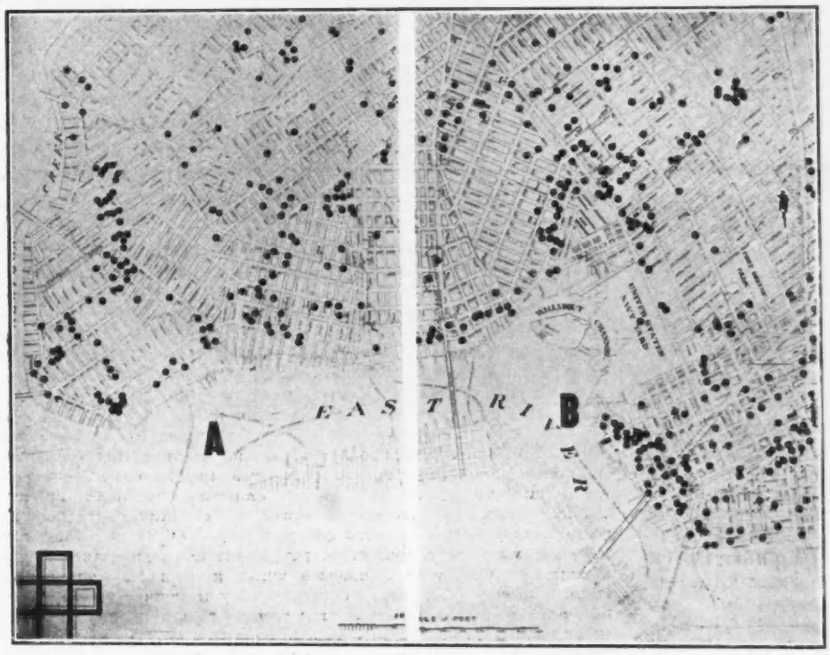


FIG. 1—MAP OF SECTION OF BROOKLYN SHOWING LOCATION OF INDUSTRIAL MOTOR USERS

The basis of each census was a thorough plant-to-plant canvass, which produced the essential information. In New Jersey the census was made not by the company's motor-service salesmen but by special census takers. The cities were covered street by street. Each city was divided into sections, each section having a distinguishing number and the files for the different divisions being kept at the respective division offices. The data include the name, location and industry of the prospective customer and full information as to boiler size, rating of prime mover, style and make. If electric drive is employed, the rating and type of generator are recorded, together with the number of motors and the kind of service used, whether alternating-current or direct-current. If steam is used in the process, it is so indicated, and any peculiar condition is noted. The information is tabulated on plant-record cards bearing a serial number and indexed by the industry and also by the prospective customer's name. In other words, both a "Prospective Customer Card" and an "Industry Card" are on file. Copies of engineering reports, tests and letters pertaining to such plants are kept in letter folders, in a vertical file, each folder bearing the serial number of the prospective customer as given on the census card.

Preparation of Map by Districts

From this file of carded information a map was devised—a map that cut the territory into districts and on which was marked with pasted stars the position of every prospective motor installation. The color and marking of the star paster indicate the size of the plant, the amount of competitive power now in use on the premises, the kind of power now installed, whether isolated electric plant, or what not, and also the serial number of the plant. Similar stickers are pasted on the plant-record cards to give the same information. The approximate horse-power of the plant is indicated by the color of the sticker.

In the Brooklyn Edison company's index a green star indicates an installation smaller than 25 hp, a red star means that the equipment is rated between 25 hp and 50 hp, a blue star indicates that the rating is between 50 hp and 200 hp, and a gold sticker shows that the installation is over 200 hp. If central-station energy is used exclusively in the plant, two parallel lines are drawn across the star. If both isolated-plant equipment and central-station service are employed, only one mark is made across the star. The result is, therefore, a clear picture of the position, character and extent of the unsold motor-service market which is particularly impressive.

Other Departments Find the Census Useful

This map and file have many uses. The industrial engineering department is able to tell the proportion of any industries not yet served with central-station energy and to direct intelligently campaigns for new business.

PLANT RECORD — Serial No. A-111

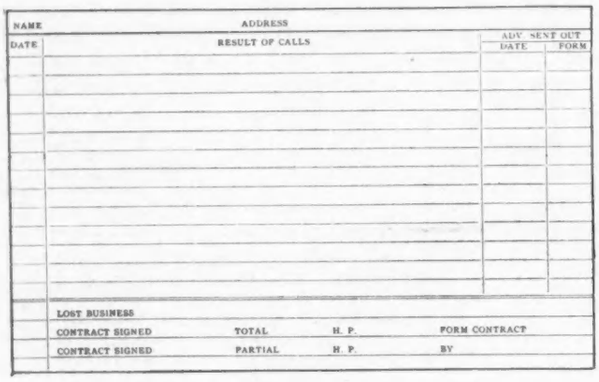
NAME	John Doe Brewery.				
ADDRESS	17 Bushwick Place,				
BUSINESS	Brewery				
NO. BOILERS	4	TOTAL H. P. 1120	TYPE Water Tube	GAGE PRESURE 150 Lbs.	
NO. ENGINES	9	TOTAL H. P. 900	TYPE Corliss	AGE 12 yrs.	COND. NON-COND. Non-Cond.
NO. DYNAMOS	2	TOTAL K. W 200	A. C. D. C. D.C.	VOLTS 120	PHASE
NO. MOTORS	10	TOTAL H. P 100	TOTAL NO. LAMPS (INCANDESCENT) 500	(ARC) 10	
NO. ELEVATORS	2	TYPE 1 Belt Driven; 1 Electric.			
ADDITIONAL APPARATUS	20 Steam Pumps (for brewing purposes)				
HEATING SYSTEM	Live - Direct	OTHER USE OF STEAM Pasteurizing, Cooking, etc			
KIND OF COAL	#1 Buckwheat	TOTAL TONS PER YEAR 8,000			
HELP EMPLOYED	1 Chief Engineer; 2 Assistants.				
APPROXIMATE COST OF POWER PER YEAR	$25,000. per year				
REMARKS					
DATE	August 14th, 1913.	REPORTED BY G.D.T.			

FIG. 2—BROOKLYN COMPANY'S PLANT-RECORD CARD

The salesman by consulting the census file can prime himself for every call on a prospective motor-service customer by referring to kindred installations in other industries. The distribution department can utilize the map as an index to the future growth of motor-service business and as a guide in selecting routes for feeder extensions. The map is thus a factor, in short, in every

situation where the probable growth of power business must be forecast.

In conjunction with this census file there has also been instituted a special salesman's card file, each card representing a prospective motor case on which some salesman is working. On these cards appear the names, addresses and classifications of the "prospects," the names


NAME ADDRESS

DATE | RESULT OF CALLS | ADV. SENT OUT: DATE | FORM

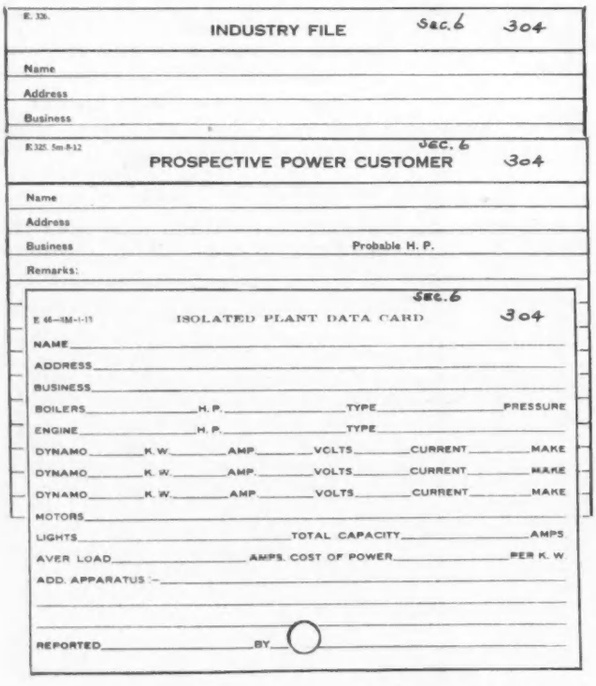
LOST BUSINESS

CONTRACT SIGNED TOTAL H. P. FORM CONTRACT

CONTRACT SIGNED PARTIAL H. P. BY

FIG. 3—REVERSE SIDE OF BROOKLYN EDISON COMPANY'S PLANT-RECORD CARD

of the men to be interviewed, and the names of the architects, consulting engineers and builders, with their addresses and telephone numbers. In addition, the cards bear index numbers corresponding to the plant-record cards referring to the same installation. Each day as a salesman turns in his report it is summarized and entered on the back of the salesman's card. When the business is finally secured or lost a record thereof


E 328. INDUSTRY FILE Sec. 6 304

Name

Address

Business

E 325. 5m-8-12 PROSPECTIVE POWER CUSTOMER Sec. 6 304

Name

Address

Business Probable H. P.

Remarks:

E 46—3M—1-15 ISOLATED PLANT DATA CARD Sec. 6 304

NAME

ADDRESS

BUSINESS

BOILERS H. P. TYPE PRESSURE

ENGINE H. P. TYPE

DYNAMO K. W. AMP. VOLTS CURRENT MAKE

DYNAMO K. W. AMP. VOLTS CURRENT MAKE

DYNAMO K. W. AMP. VOLTS CURRENT MAKE

MOTORS

LIGHTS TOTAL CAPACITY AMPS

AVER LOAD AMPS. COST OF POWER PER K. W.

ADD. APPARATUS:-

REPORTED BY

FIG. 4—SYSTEM OF CARDS USED BY PUBLIC SERVICE ELECTRIC COMPANY OF NEW JERSEY

is made on both the salesman's and the plant-record cards.

This combined equipment makes a working system that has proved most effective both in Brooklyn and in New Jersey and can well be adopted by any central station, large or small. The census file provides adequate data for the proper preparation of preliminary propositions for practically any prospective motor user, and the map presents a clear and comprehensive survey of the entire immediate market. It is a stimulative influence of the highest value.

Neglect Not the Humble Testimonial

Fortunes have been made from testimonial advertising because people readily believe the statements of their neighbors concerning almost anything upon which they themselves have not formed definite opinions. Sometimes a sincere testimonial will change a well-established conviction.

Realizing the value of putting before the public friendly letters received from their own number, the Dayton (Ohio) Power & Light Company has framed a few typical ones and hangs them along the wall where patrons waiting to pay bills cannot fail to see them. The contents of two letters which are representative of those used are reproduced herewith:

"841 ARBOR AVENUE, DAYTON, OHIO, Sept. 30, 1913.

"THE DAYTON POWER & LIGHT COMPANY, Dayton, Ohio:

"GENTLEMEN:—It gives me great pleasure to write this little note of thanks for the promptness shown by you in furnishing me light. On Wednesday of last week the inspector 'O.K'd' the wiring and fixtures at my house and said he would report to you at once. On last Friday morning I called at your office to inquire when I might expect to use the electricity, and your man said the linemen had my name and would probably be able to reach me by Saturday. I explained that I was very anxious to have the light turned on then, but he could not promise this for sure. Imagine my very great surprise when reaching home Friday evening I found that your linemen had connected my house up, set the meter, and the house was lighted. I am highly gratified at such prompt service, and assure you that I will always use my influence with my neighbors to put in electric lights, for it is a pleasure to deal with a concern which gives such prompt and efficient service. My first impression of your company is a most agreeable one, and I trust I may always remain a steady (even though small) user of your service. Again thanking you for the courtesy thus shown me, I am, yours very truly,

"A. L. MURLIN."

"BINGHAMTON, N. Y., March 13, 1915,

"THE DAYTON POWER & LIGHT COMPANY, Dayton, Ohio:

"GENTLEMEN:—I wish to say that I was surprised to learn that an electric-light company would refund overcharges paid, especially after the payer had left the city. Although I was honorable in sending you the money order after I had left Dayton, many people would not have returned to me the 34 cents as you did. . . . May more of your lights shine in Dayton—although Dayton is now a well-lighted city. Yours truly, JNO. E. GABLE."

Iowa Electrical Contractors Discuss House Wiring and Accounting

At the convention of the Iowa Electrical Contractors' Association held at Keokuk, Ia., April 20, 21 and 22, several of the delegates urged that the soliciting and sales expense incurred in house-wiring campaigns should be borne by electrical contractors instead of by the central stations as is the usual practice. Central stations could then, it was said, devote their efforts to educating the public to the new uses of electrical energy.

In a talk on estimating one contractor told of an estimate sheet developed by him which has a column for entering the exact costs of detailed parts of a job as these parts are completed. This column has been placed beside the column provided for estimated costs, and when a job has been completed the estimated and actual costs can easily be compared. Future estimates can then be made to approximate more closely to actual costs.

At a business session the association indorsed for use by its members the Modern Mechanical Contractors' Accounting System, which is being published by the H. & W. Accounting Bureau of Rock Island, Ill.

The system was designed by Mr. G. W. Hill, former special agent for the National Electrical Contractors' Association.

Five Miles of Gas-Filled Tungsten Boulevard Lighting at Indianapolis

Meridian Street, the main north and south thoroughfare of the Hoosier capital, is now illuminated for a distance of 5 miles by gas-filled tungsten lamps carried on ornamental cast-iron single-lamp standards. Lamps of the 10-amp, 150-cp and 250-cp types are used, inclosed

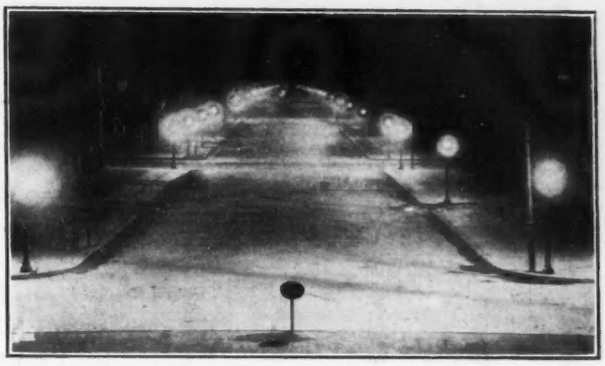


FIG. 1—MERIDIAN STREET, INDIANAPOLIS, LOOKING NORTH

in 8-in. by 16-in. round Alba globes. The spacing of these units is somewhat unusual, four 250-cp lamps being placed on the corners of each street intersection and 150-cp lamps being staggered at regular intervals on both sides of the street within each block. This arrangement of the units gives, of course, much greater light intensity at the street intersections than elsewhere along the thoroughfare.

The steel-taped cable, inclosing a No. 8 solid-copper cambric-insulated conductor which supplies energy to these lamps, was laid just at the outer edge of the sidewalk in the narrow strip of lawn between the sidewalk and the curb. This position for the conductor was selected in preference to the usual place beneath the street gutter, so that the possible future widening of

FIG. 2—A STREET INTERSECTION AND AN OLD ARC LAMP WHICH WILL BE REMOVED

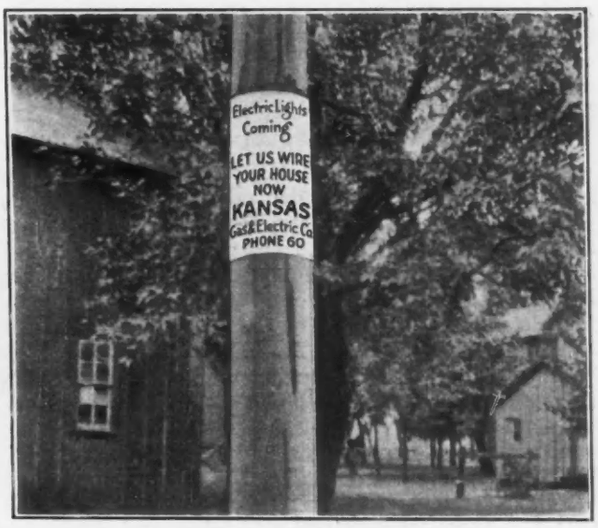
Meridian Street will not necessitate removal of the circuit. One of the photographs herewith, taken when the lamps were first placed in service, shows a general view of Meridian Street looking north from Monument Place at the center of the city. The others give more detailed views of the new lighting and also show the types of illuminant being replaced by the tungsten lighting. The lamps for this installation were supplied by the Westinghouse Lamp Company and the Bryan-Marsh Division of the National Lamp Works of the General Electric

FIG. 3—OLD GAS LAMP AND NEW GAS-FILLED TUNGSTEN STANDARD

Company. The cast-iron standards are of the "Parkview" type made by the George Cutter Company.

Heralding the Advance of the Conqueror

When summer pole-line construction was at its height at Independence, Kan., last season, the local new-business department of the Kansas Gas & Electric Company capitalized the efforts of the sturdy construction crew to secure publicity for its service. Wherever a new pole



STENCILED SIGN ON NEW POLE

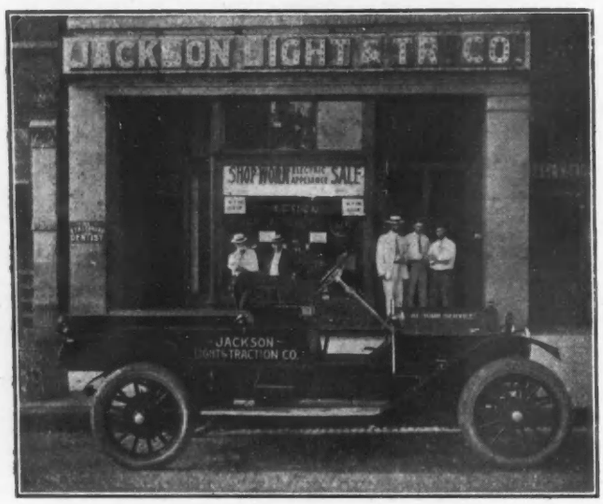
was erected, whether it replaced an old pole or was set in an entirely new location, a cardboard stenciled sign was tacked to the bright new cedar.

The new poles themselves attracted attention, and the sign in its bright oil colors heralded the arrival of electric service. The signs read: "Electric lights are coming. Let us wire your house now. Kansas Gas &

Electric Company, 'Phone 60." Months later these signs were still bright and the colored letters had not "run." The men of the new-business department who prepared this timely advertising believe that it pays to use oil paints in making stenciled signs. Although these posters cost 22 cents each, they have been long-lived and have helped the house-wiring business immensely.

Selling Off Shopworn Appliances at Jackson, Miss.

Department stores and other general merchandise shops hold periodic sales in which they rid their shelves of goods which have been handled more or less by the buying public and have come to show shop wear. Following this example, the Jackson (Miss.) Light & Traction Company recently advertised and carried out a successful shopworn electric-appliance sale. Devices which had been used for demonstrating were placed in the company's show window, and the columns of the daily newspapers were used to call attention to the sale and to the prices offered on goods practically new.



OFFICE AT JACKSON DURING SALE

Electrical Refrigeration at 11.7 Cents a Day

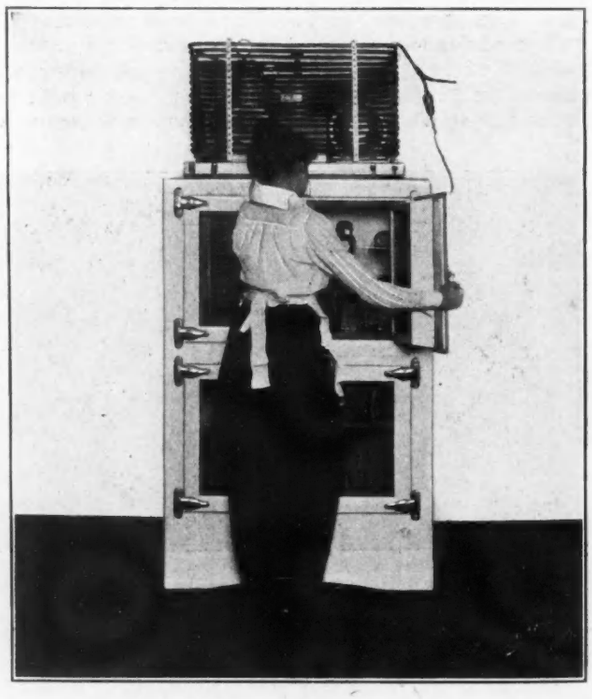
In the month of July last year Mr. R. W. Brown, manager of the Spring Valley (Ill.) Utilities Company, conducted tests on an electrical refrigerator to obtain authoritative data for the company's patrons on the average daily energy consumption of the device. The refrigerator used for the tests was of the type made by the Mechanical Refrigerator Company of Chicago (see ELECTRICAL WORLD, Aug. 22, 1914). It was 16 in. by 36 in. by 50 in. inside. During the tests the automatic thermostat was disconnected and the control was effected by hand so that accurate observations of time and temperatures could be made. The temperature of the kitchen in which the machine was operating was read five times a day, and the coil temperature was read each time the room temperature was taken and again each time the motor was started or stopped. The temperature maintained throughout the test in the warmest part of the refrigerator ranged between 40 deg. and 45 deg. Fahr., and in the compartment containing the cooling coils the temperature was considerably lower. One day during the test ice for table use was made in the refrigerator.

At a 10-cent rate for electrical energy, such as is in force at Spring Valley, its average daily cost amounted to 11.7 cents. Since this economical record has been made Mr. Brown has told many of his customers of the outcome, and he expects to sell a number of these machines during the coming season. The lines of the Spring Valley Utilities Company extend over several counties, and among rural customers especially this device is expected to be popular. The data observed by Mr. Brown are given in the accompanying table.

OPERATING DATA ON A MOTOR-DRIVEN REFRIGERATOR

Date, July, 1914	Temperature of Room	Temperature of Coils	Pressure in Lb. per Sq. In.	Operation per Day		Kw-hr.
				Hours	Minutes	
1	76	80	50	3	35	0.6
2	80	90	50	5	30	1.1
3	83	100	70	5	30	1.3
4	85	93	60	5	15	1.1
5	84	94	50	6	25	1.3
6	80	91	54	5	30	1.1
7	86	93	60	8	25	2.3*
8	83	96	50	6	05	1.2
9	87	92	48	5	0	1.
10	87	92	72	6	60	1.5
11	82	88	45	5	30	1.1
12	88	88	60	5	30	1.3
13	90	88	66	6	..	1.55
14	82	91	58	4	30	0.90
15	86	96	64	6	..	1.25
16	84	94	56	5	..	1.0
17	81	90	48	5	30	1.1
18	77	88	50	5	..	1.
19	84	92	53	5	..	0.9
20	76	90	66	6	..	1.20
21	88	95	60	5	30	1.1
22	90	94	55	6	25	1.3
23	93	98	73	6	15	1.4
24	84	95	60	6	..	1.2
25	81	96	50	4	0	0.8
26	80	93	62	5	30	1.1
27	80	90	60	6	30	1.3
28	80	84	58	4	30	0.8
29	78	84	45	5	15	1.1
30	76	94	46	5	30	1.1
31	83	94	58	6	0	1.2
Total				163	30	36.20
Daily average				5	16	1.17

*Making ice.



HOUSEHOLD ELECTRIC REFRIGERATOR USED IN TESTS

NEW APPARATUS AND APPLIANCES

Vertical Two-Stroke-Cycle Diesel Engines

Vertical two-stroke-cycle multi-cylinder engines operating on the Diesel principle have recently been developed for marine and stationary service by the Southwark Foundry & Machine Company, Washington Avenue and Fifth Street, Philadelphia, Pa. In the accompanying illustration is shown a four-cylinder 150-hp engine directly connected to a 100-kw generator.

The scavenging pump or low-pressure compressor is of the step-piston type—that is, the piston of the scavenging pump is an enlarged extension of the main piston working in its own cylinder below the working cylinder. The function of this pump or compressor is to draw a charge of air from the atmosphere and blow it through the working cylinder, thereby blowing out into the exhaust pipe the previously burned charge and leaving the cylinder full of pure air which will afterward be compressed by the working piston on its inward stroke. The compressor is also utilized in starting and reversing the engine. Compressed air for starting and reversing the engine and scavenging the cylinders is furnished by a multi-stage air compressor directly connected to the engine shaft. Tanks are employed for storing the compressed air. When the air in the working cylinder is compressed to a pressure of about 500 lb. per sq. in. oil is passed through an atomizer and is injected into the cylinder. As the compressed air is at a temperature of about 1000 deg. ignition immediately takes place.

On pushing the starting lever forward or backward, the suction and delivery valves are automatically cut out, and the air-starting valves automatically come into play with the cam shaft; the compressed air acts on the pistons in the scavenging cylinders, and the engine is started or reversed as desired. By the continual moving of the so-called handling lever, the atomizers begin to open and the fuel is supplied to the working cylinders.

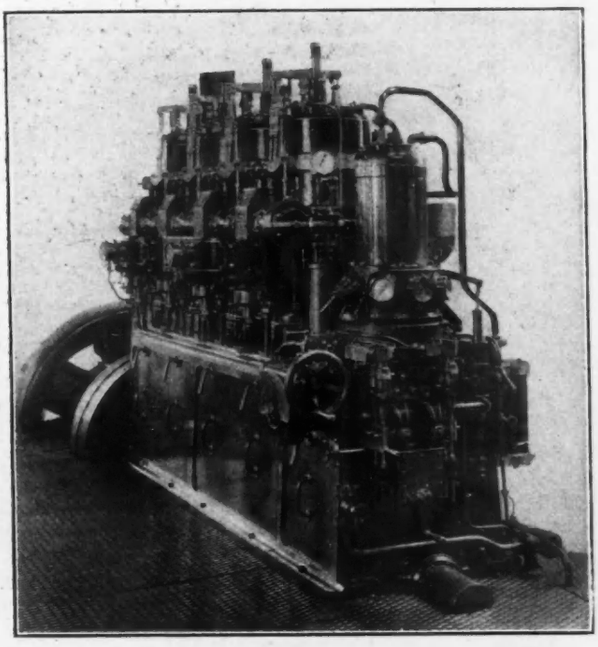


FIG. 1—FOUR-CYLINDER VERTICAL ENGINE DIRECTLY CONNECTED TO GENERATOR

The area of the pistons in the scavenging cylinders is greater than that of those in the working cylinder, and as a result the engine can be started with air at a pressure as low as 110 lb. per sq. in. It is possible to start the engine under load.

Cards No. 1 and No. 2, shown in Fig. 2, were taken from the scavenging cylinder while starting the engine

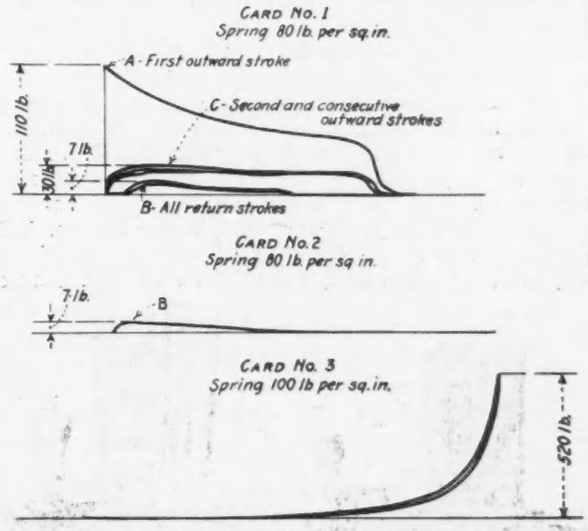


FIG. 2—CARDS TAKEN WHILE STARTING ENGINE WITH COMPRESSED AIR

on compressed air, no oil being admitted to the working cylinders. Card 3, also shown in Fig. 2, was taken from the working cylinder at the same time. Line A shown on Card 1 represents the first outward stroke or initial inlet of air, showing that it required 110 lb. per sq. in. to act on the piston in the scavenging cylinder to force inward the adjacent main piston against its compression (about 500 lb. per sq. in.). Line B represents the return stroke of the scavenging-cylinder piston and shows that it performed its normal function of compressing a charge of scavenging air to 7 lb. per sq. in. Line C represents the second and all consecutive outward strokes until the starting air is shut off by the operator, line D representing each return stroke.

There are no valves in the cylinder heads of the engine. The scavenging air is admitted to the working cylinder through ports in its circumference. The exhaust gases pass out through ports opposite the scavenging ports. The governor is of the centrifugal type and acts directly on the fuel pump by varying the strokes of all the pumps at one time.

Starters for Induction Motors

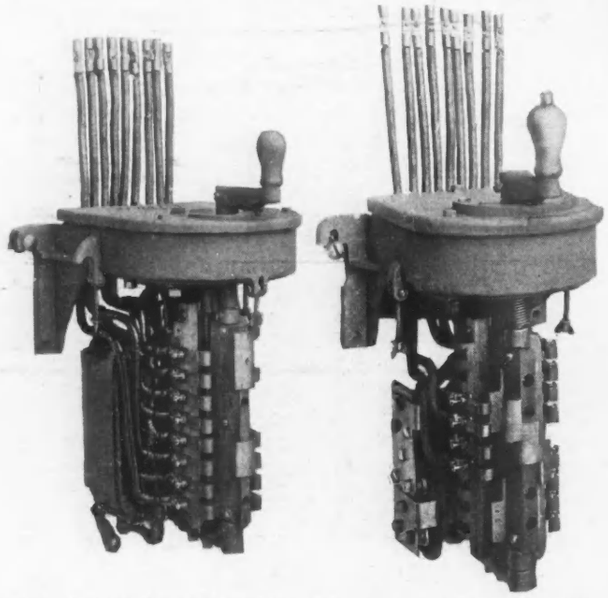
Starters of the transformer or compensator type and of the resistance-coil type for use with squirrel-cage induction motors have been developed by Fairbanks, Morse & Company, Chicago, Ill. The former are employed with motors rated at 20 hp or above, and the latter with machines with ratings of 7.5 hp to 20 hp.

In Fig. 1 is shown a compensator starter with cover and oil tank removed. It consists of two auto-transformers mounted on a cast-iron frame and a drum-type switching mechanism which are immersed in oil contained in a tank suspended from the frame of the starter. The connecting leads are sealed in the starter frame to exclude moisture and dirt and to relieve the terminals within the starter of all strain. The oil tanks can be removed without removing the compensator from its mounting or disturbing any of the connections. The

switching mechanism consists of a series of fixed contact fingers and a set of contact plates mounted upon a drum which is turned in one direction for starting and in the opposite direction for running. It is impossible to reach the running position without first passing through the starting position.

The contact fingers are provided with removable tips which are reversible, thus giving double the wear of ordinary contact tips. Each coil has three taps, giving 55 per cent, 70 per cent or 80 per cent of full voltage under load, so that the starting torque and current may be varied according to the motor service required.

The starter shown in Fig. 2 consists of a starting switch and a set of resistance coils, all immersed in a tank of oil. In operation the starting handle is moved from the off position to the first stop, thereby connecting the motor to the line through the resistance coil. By pressing down a thumb-piece in the handle, it is then moved to the second stop, and all resistance is cut out, the motor, however, being still connected back of



FIGS. 1 AND 2—COMPENSATOR STARTER AND RESISTANCE-TYPE STARTER WITH OIL TANKS REMOVED

the overload protective devices. Again pressing down the thumb-piece, the handle is moved to the running position, and the motor is then connected directly to the line through the running fuses or circuit-breaker. It is not possible for the operator to hold down the thumb-piece and pass the stops without pausing, and if the handle is released before reaching the running position it will be automatically returned to the off position. No-voltage-release mechanisms are provided for both types of starters.

Large Electrically Operated Refrigerating Machine

What is said to be the largest motor-driven refrigerating machine in operation in this country has recently been installed in the plant of the Jacob Dold Packing Company, Buffalo, N. Y. The machine is employed primarily as a reserve unit and to supplement steam-driven machines. It is operated only at night, when energy can be purchased at a low price.

The ammonia compressor is a horizontal 400-ton single-acting unit and is driven by an Allis-Chalmers 600-hp motor which operates at a speed of 290 r.p.m. on 2200-volt, 116-amp, three-phase, twenty-five-cycle energy. The motor is of wound-rotor construction and is provided with three bearings. Use is made of a drum controller designed to give 50 per cent speed reduction.

Ammonia gas enters the cylinder at the center of the compressor through grated ports. The suction valves

FIG. 1—VIEW SHOWING BOTH SIDES OF COMPRESSOR

are in the piston heads and are without springs. The discharge valves are in the bottom of the cylinder and are of the poppet type. A portion of the cylinder where the cold gas enters is cork-insulated, while the ends, which are subject to the heat of compression,

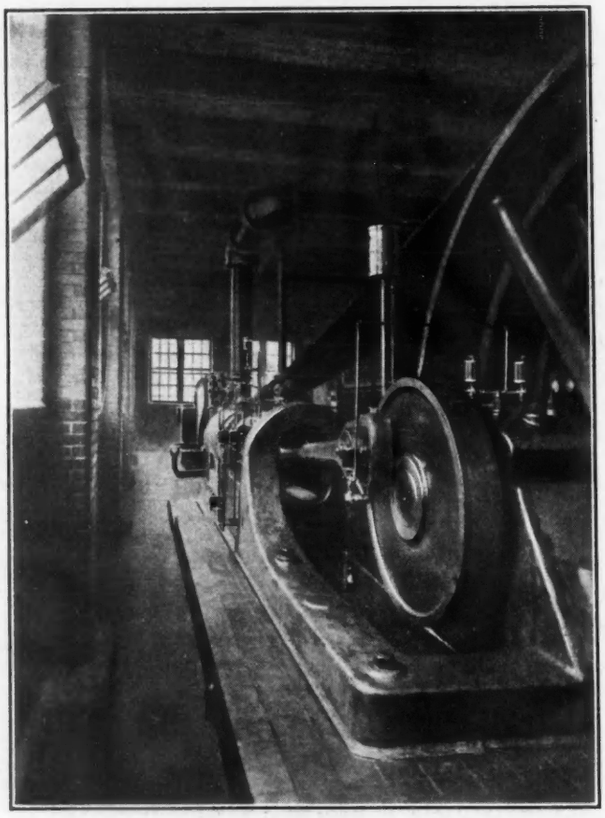


FIG. 2—VIEW SHOWING ONE SIDE OF COMPRESSOR AND MOTOR

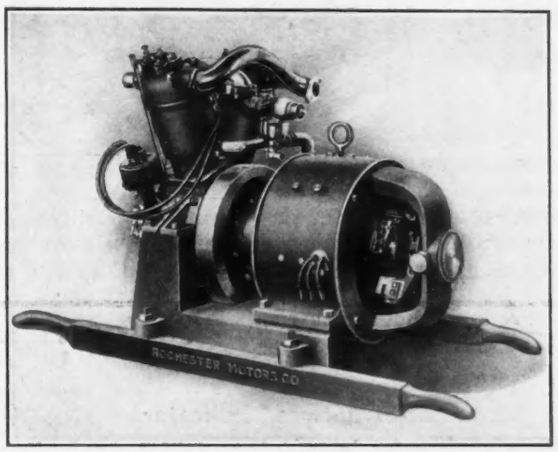
the heads and a part of the stuffing box are water-jacketed.

The ammonia condenser is of the under-shot atmospheric type and is made of 2-in. wrought-iron pipe arranged in thirty-six coils, each coil having twenty

pipes and being 21 ft. long. Two ice tanks are provided on the second floor of the building about 150 ft. away from the compressor. These are 63 ft. 4 in. long, 17 ft. 7.5 in. wide and 60 in. deep. At one end of the tank are two Arctic-Pownall shell brine coolers, through which brine is circulated by means of two arctic horizontal agitators, which are equipped with 22-in. blades and are operated by 5-hp motors. Blocks of ice weighing 400 lb. are produced. The refrigerating machine was made by the Arctic Ice Machine Company, Canton, Ohio, and was installed under the direction of Mr. George Schautz, consulting engineer of the Dold company.

Electric Generating Outfit with Cycle-Car Engine

A small generating set developed by the Rochester Motors Company, Rochester, N. Y., for use with cycle-car engines which it is manufacturing, is particularly



SMALL GASOLINE-ENGINE-DRIVEN GENERATING SET

well adapted, the manufacturers declare, for use with "wireless" apparatus on ships. It can also be utilized to supply motion-picture equipment. The complete outfit, including engine, generator and base, weighs approximately 400 lb. The unit gives a continuous output of 2 kw and an output of from 2.5 kw to 3 kw for intermittent service. The generator is of the interpole type and is equipped with a cast-steel frame and pressed-steel ventilating fan. Use is made of ball bearings which are packed in non-fluid oil. According to the manufacturer, very good regulation is obtained, and it is possible to throw the entire load off and on with only a momentary fluctuation in voltage. The outfit is designed to operate a motion-picture arc lamp in addition to from ten to twenty-five incandescent lamps.

Shade Holder

A 2.5-in. shade holder recently developed is shown herewith. The holder is fitted with a contractile collar which is said to give rigidity and central suspension. A

SHADE HOLDER WITH CONTRACTILE COLLAR

deeply curved skirt is provided which, as claimed by the manufacturer, Harvey Hubbell, Inc., Bridgeport, Conn., allows ample neck room for any type of shade.

Connectors

Several devices for making rapid and frequent electrical connections have recently been developed by the Universal Electric Stage Lighting Company, 240 West Fiftieth Street, New York. They are rated at from 5 amp to 200 amp for 110-volt, two-wire systems, and

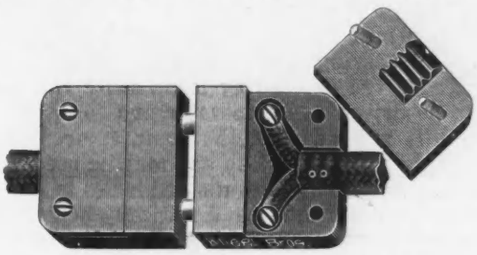
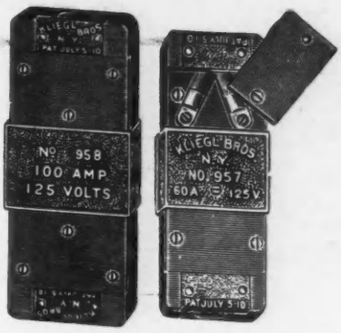


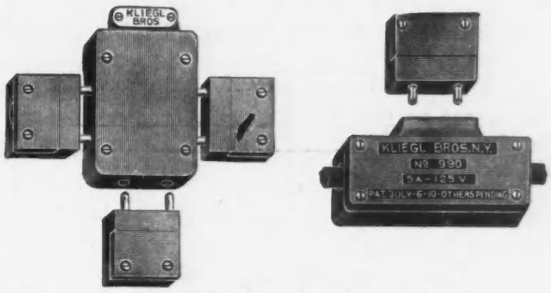
FIG. 1—STAGE CONNECTOR

at from 5 amp to 60 amp for 125-volt to 250-volt, three-wire systems. The bases of the receptacles and plugs of these connectors consist of hard black-fiber blocks varying in thickness from 11/16 in. in the 5-amp connectors to 1 3/16 in. in the 100-amp devices. The contacts are of brass and are fastened securely in the fiber bases. The extending ends of the male part of the connectors are sawed lengthwise through the center to form spring contacts with the sleeves. The brass parts in the fiber bases are provided with binding screws and lugs. Each part of each connector is provided with a cable clamping device for holding the cable firmly by



FIGS. 2 AND 3—CONNECTORS FOR CHARGING BATTERIES IN GARAGES

its outer insulation and for relieving the strain on the terminals as shown in Fig. 1. The covers of these connectors forming part of the cable clamp are provided with ribs on the underside over the wire opening, which are driven into the surface of the insulation on the cable. The connector shown in Fig. 1 is designed particularly for use with stage-lighting apparatus. The devices shown in Figs. 2 and 3 are adapted for use with

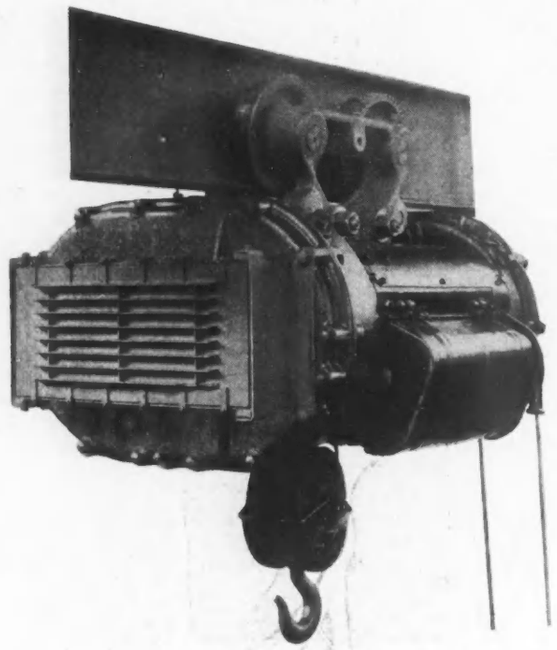


FIGS. 4 AND 5—MULTIPLE STAGE CONNECTOR AND BRANCH-OFF CONNECTOR

storage batteries in garages and are not reversible. A multiple stage connector is shown in Fig. 4 and a branch-off connector is illustrated in Fig. 5.

Electrically Operated Hoist

The electric hoist shown herewith is especially designed for service where there is small head room. All parts of the machine are fully inclosed. By removing one of the sheet-steel covers the hoist motor is exposed and may be removed as a unit for repairs without disturbing any of the other parts. Use is made of cut-steel gears which run in oil and automatically splash-lubricate all bearings. A dynamic braking system is used whereby the descending loads cause the hoisting motor to be driven as a generator and to operate as a brake. It is well adapted, the manufacturers declare, for careful handling of a load and may be used for lifting and lowering flasks, patterns and ladles in foundries. A powerful solenoid brake automatically holds the load when the supply of energy is shut off. Adjustable upper and lower limit "stops" automatically break the circuit

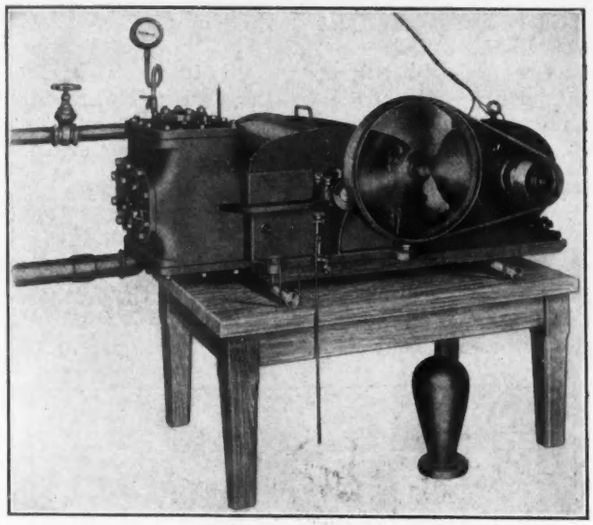


ELECTRIC HOIST

and apply the brake when the load reaches its predetermined limits of travel. The hoist may be equipped with a plain trolley, a geared trolley, a motor-driven trolley or a motor-driven trolley with operator's cage suspended from the machine. It may be also employed with shackle or hook suspension (in place of trolley), making it a stationary hoist. The hoist is being manufactured by the Link-Belt Company, Chicago, Ill.

Motor-Driven Double-Acting Triplex Pump

To demonstrate to visitors the balanced adjustment of its double-acting triplex pump, the apparatus shown herewith has been assembled and placed on display by the maker, the Luitwieler Pumping Engine Company, at its factory at Rochester, N. Y. The pump rests on a pair of 2-in. polished-steel rollers which are laid on the top of a table. There is no air chamber on the pump, and the manufacturer reports that when the machine is operating the gage needle stands still, showing that the water pressure is constant. To show that no vibration exists, a wire nail is placed on end on the housing of the pump as shown. On both sides of the rollers other nails stand on end and touch the rollers. If any movement of the rollers occurred, the nails would topple over. However, it is reported, that the pump operates at speeds from 100 r.p.m. to 300 r.p.m. day after day with the nails standing in the same positions. These results are obtained, it is asserted, because the pump is balanced in both its rotating and its reciprocating parts and the water is kept moving in constant vol-

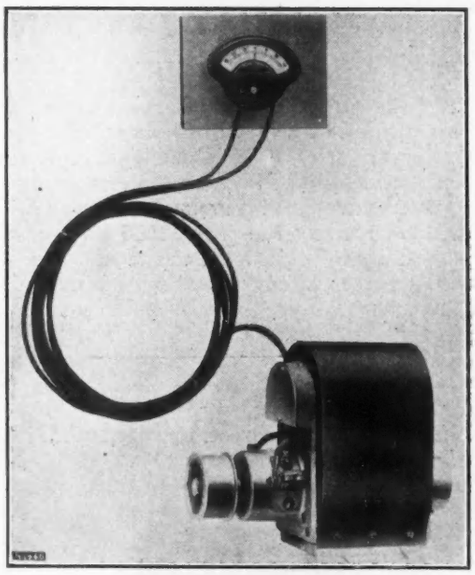


DOUBLE-ACTING TRIPLEX PUMP MOUNTED FOR DISPLAY

ume and pressure without variation. The driving mechanism of the pump consists of three symmetrical cams placed on a shaft 120 deg. apart, the cams being so designed that the water is moved at constant speed and pressure throughout the cycle.

Electric Speed Indicator

The apparatus for determining machine speeds shown herewith consists of a generator of the magneto type and an electrical indicating instrument. The generator is so designed that the voltage developed is directly proportional to the speed at which the armature is driven. A



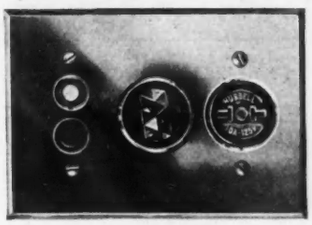
ELECTRIC SPEED INDICATOR

voltmeter connected to the terminals of the generator will indicate, therefore, the speed of the device to which the machine is coupled. With such a tachometer the indicating instrument can be at a distance from the genera-

tor, and can be placed where it is not affected by vibration, heat, etc. The armature of the generator has a large number of slots and commutator segments, and the coils embedded in the slots are held in place with fiber wedges. A compartment wall on the commutator prevents oil and worn particles of the commutator and brushes from getting into the ball bearings. The indicating instrument is of the D'Arsonval type, and the manufacturer claims that it is absolutely dead-beat. The instrument is provided with a zero-adjusting device and can be calibrated in terms of revolutions per minute, miles per hour, etc. The manufacturer, the Esterline Company, Indianapolis, Ind., recommends the device for use in measuring speeds of steam locomotives, street-railway cars, steamships, printing presses, etc.

Indicating Heater Receptacle

A bull's-eye indicating heater receptacle rated at 10 amp and 125 volts has recently been developed by Harvey Hubbell, Inc., Bridgeport, Conn. The plug designed



BULL'S-EYE INDICATING RECEPTACLE

for use with the receptacle is provided with T-slot contacts which permit the interchanging of seventeen different types of caps. The four supporting screw holes are spaced vertically on 3 9/32-in. centers and horizontally on 3 5/8-in. centers. The device is designed for use with three-gang wall boxes.

Automatic Section Insulators for Mine Trolley Wires

Insulators designed for use with trolley wires in mines for energizing a section when the trolley passes onto it, and de-energizing it when the trolley passes

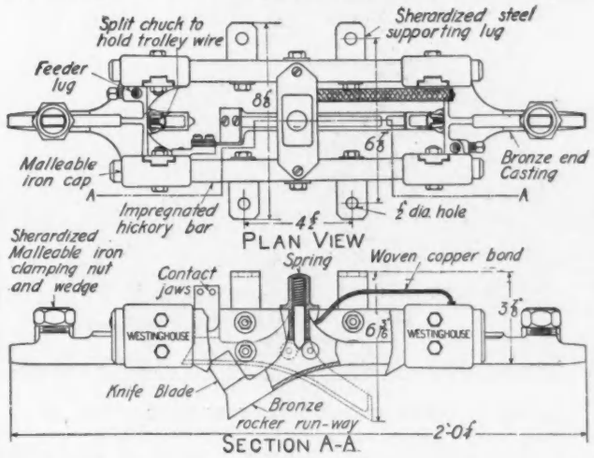


DIAGRAM OF SECTION INSULATOR FOR TROLLEY WIRES IN MINES

off, have recently been developed by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. By means of this device leakage losses and danger of contact by persons passing under the trolley wire are averted when the locomotive is not on the section. The circuit is opened and closed by a switch blade mounted on a rocker which is operated by the contact wheel. A brass plunger pressing against a steel roller prevents the rocker from remaining in an intermediate position. No arcing can occur at the switch contacts, because the rocker is always energized and the switch connection is always opened or closed while the trolley wheel is on the rocker. Stress is taken by side bars of impregnated hickory. All metal parts are either sherardized or are of bronze. The wedges utilized to hold the trolley wire are supplemented by an internally threaded chuck. A flexible woven-copper bond carries energy to the switch blade on the rocker.

Portable High-Frequency Oscillators

A portable high-frequency 125,000-volt oscillator for testing porcelain high-tension line insulators and bushings, recently developed by the General Electric Company, Schenectady, N. Y., is designed for operation on twenty-five-cycle, forty-cycle and sixty-cycle circuits at a pressure of 110 volts or 220 volts. It takes 1.5 kva at twenty-five cycles, 2 kva at forty cycles and 2.5 kva at sixty cycles, and will deliver energy at frequencies of approximately 300,000 cycles and at pressures up to about 165,000 volts.

The equipment consists essentially of a 13,000-110/220-volt step-up transformer, a condenser placed across

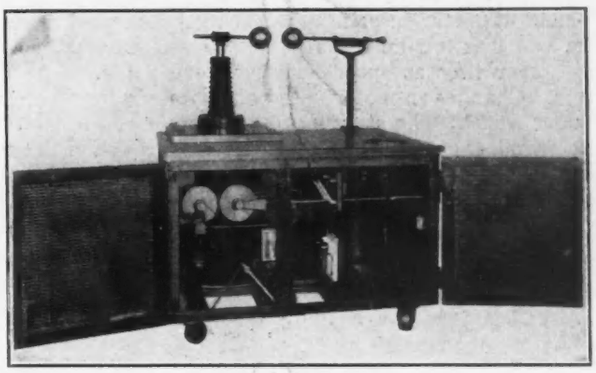


FIG. 1—125,000-VOLT HIGH-FREQUENCY OSCILLATOR

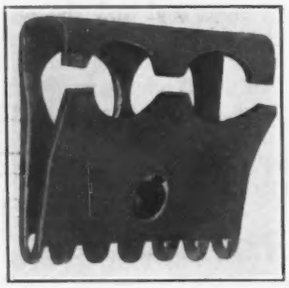
the terminals of the high-voltage coils of the transformer, an adjustable control gap, an oscillation transformer, a properly proportioned sphere gap and suitable reactance to protect the step-up transformer against the damaging effect of short-circuit when a spark takes place at the control gap.

As the voltage across the control gap increases the condenser becomes charged; when there is sufficient voltage to spark across the control gap the charged condenser becomes short-circuited, and energy surges back and forth to the circuit containing the condenser, the control gap and the low-tension side of the oscillating transformer, each surge being less in value than the preceding surge until the surges cease.

Five suspension-type insulators can be tested in multiple, it is declared, at a pressure of 80,000 volts and a frequency of 300,000 cycles per second. Where transportation conditions permit, the oscillator can also be used to test suspension insulators in place on the line. Under the same conditions the oscillator can be used to test a pin insulator, provided that it is mounted on a dry wooden cross-arm or on a metal cross-arm carried on a dry wooden pole and is not connected to a ground wire.

Fastener for Flexible Tubing

A flexible-tubing fastener made of a single piece of 1/16-in. sheet steel and bent to shape as shown in the accompanying illustration is being made by Thomas E. Hopson, 134 Bank Street, Ottawa, Ont. The clamping action is obtained by tightening a flat-headed wooden

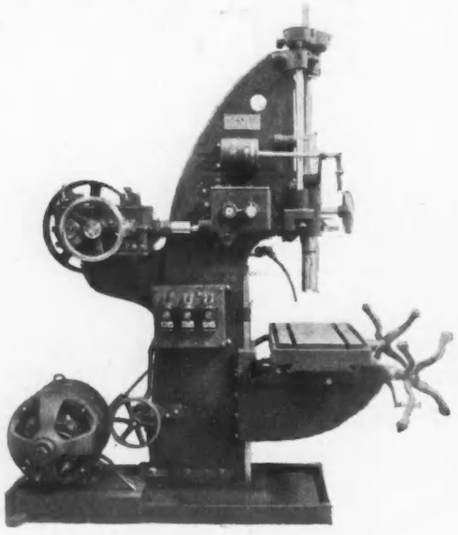


FASTENER FOR FLEXIBLE TUBING

screw which passes through the fastener and which draws down the hinge-like piece on top. Two spurs are punched out of the bottom to prevent the device from turning. The fastener occupies a space about 1 7/16 in. square.

Motor Drive for Drill Press

In the accompanying illustration is shown a heavy-duty Colburn drill press operated by an adjustable-speed motor, which is designed to drill holes as large as 2 in. in diameter in solid steel, using high-speed drills. The motor is a 5-hp machine of the armature-shifting type, operating at speeds of from 450 r.p.m. to 1800 r.p.m. Changes in motor speed are obtained by turning a hand wheel. The starting and stopping of the motor is controlled by an automatic starter through a drum switch. This switch is provided with "forward," "reverse," "drift" and "brake" points. When the switch is thrown to the "brake" position the motor and drill are

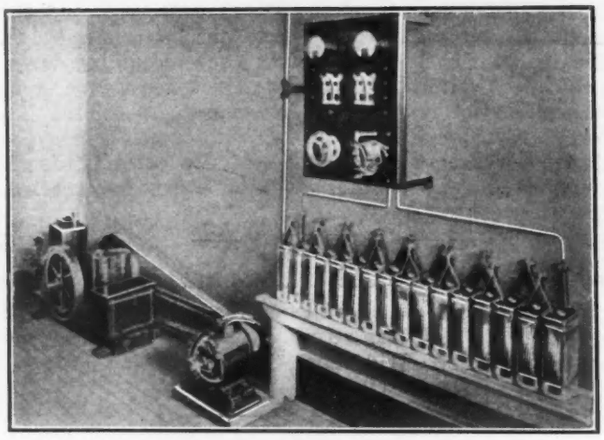


MOTOR-DRIVEN HEAVY-DUTY DRILL

brought to a quick stop. The drum switch is provided with a special extension so that it can be easily operated in the front of the machine. The motor for operating this machine was made by the Reliance Electric & Engineering Company, Cleveland, Ohio, and the control apparatus by the Electric Controller & Manufacturing Company, also of Cleveland.

Small Gasoline-Engine-Driven Lighting Outfit

Lighting sets with ratings of 0.25 kw to 1.5 kw are being made by the Lauson-Lawton Company, De Pere, Wis., and are operated by gasoline engines with ratings of 1.5 hp to 6 hp. An 0.6-kw plant is shown in the accompanying illustration. The generator operates at

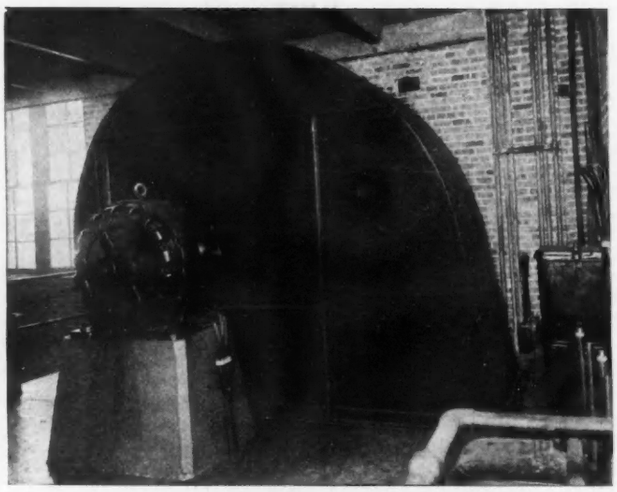


SMALL LIGHTING PLANT

15 amp and 40 volts, at a speed of 1800 r.p.m. The switchboard is of black-enameled slate and measures 18 in. by 24 in. On this board are mounted a voltmeter, an ammeter, switches and a circuit-breaker. In case the engine should stop, the circuit-breaker automatically connects the lighting circuit to the battery, which is of the sealed type.

Large Blower for Cooling Air-Blast Transformers

In the accompanying illustration is shown a large fan installation for cooling air-blast transformers at the Blue Island power station of the Public Service Company of Northern Illinois, Chicago, Ill. The fan was installed by Sargent & Lundy and consists of a directly connected blower which handles continuously 40,000



LARGE MOTOR-DRIVEN BLOWER

cu. ft. of air per minute at 70 deg. Fahr. and at 29.92 in. barometric pressure with a static increase in pressure of 2.6 in. of water gage. The blower is directly connected to a 30-hp, twenty-five-cycle, three-phase, 470-r.p.m. General Electric motor. The blower is of the "turbo-conodial" high-speed type and was made by the Buffalo (N. Y.) Forge Company.

CURRENT NEWS SECTION

International Jury of Awards, San Francisco Exposition

Following are the members of the International Jury of Awards of the Panama-Pacific International Exposition appointed to pass on all electrical exhibits: Nominated by the chief of the department of machinery—Dr. Carl Hering, consulting engineer, Philadelphia; Prof. C. M. Jansky, University of Wisconsin, Madison; Mr. William H. Onken, Jr., ELECTRICAL WORLD, New York; Mr. Cecil P. Poole, consulting engineer, Atlanta, Ga. Nominated by the chief of the department of transportation—Dean George A. Damon, Throop College of Technology, Pasadena, Cal.; Mr. A. H. Babcock, electrical engineer Southern Pacific Railroad Company, San Francisco. Nominated by the chief of the department of manufactures—Prof. V. Karapetoff, Cornell University, Ithaca, N. Y.; Prof. H. J. Ryan, Stanford University, Palo Alto, Cal.; Mr. Guy Bayley, chief of electricity Panama-Pacific International Exposition. Nominated by the chief of the department of liberal arts—Mr. A. J. Halloran, *Journal of Electricity, Power and Gas*, San Francisco; Mr. Charles A. Rolfe, president Southwest Home Telephone Company, Redlands, Cal.; Dr. Frank Wolff, Bureau of Standards, Washington. Electrical groups of all departments—Italy, Mr. Vite Capastini.

The composite jury met and organized on Monday, May 3, and chose Professor Ryan as chairman of the group, Mr. Vite Capastini as vice-chairman and Mr. A. J. Halloran as secretary. The group jury has been given twenty days to pass on exhibits and will report to a department jury composed of the chairmen and vice-chairmen of each group jury of the respective departments. Each department jury must begin work within five days after notice by the chief of the department. It will consider and review reports of group juries and will, through the chiefs of the respective departments, submit findings to the director of exhibits, who will certify these to the superior jury. The latter will determine finally and fully the awards to be made. This superior jury will convene on June 3, and will report within fifteen days, and as soon as practicable thereafter formal public announcement of the awards will be made. The merits of exhibits will be manifested by the issuance of six classes of diplomas—the grand prize, medal of honor, gold medal, silver medal, bronze medal and honorable mention without medal.

Associated Electrical Manufacturers' Committees

Mr. D. C. Durland, general manager of the Sprague Electric Works of the General Electric Company, New York, has been named as chairman of a committee to consider and recommend to the board of governors a general secretary for the Associated Manufacturers of Electrical Supplies. The other members of the committee are Messrs. J. E. Way, the R. Thomas & Sons Company, New York, and W. A. Connor, vice-president Standard Underground Cable Company, Perth Amboy, N. J.

Two members have been added to the canvassing committee, of which Mr. A. W. Berresford, general manager of the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., is chairman. They are Messrs. Walter Robbins, vice-president of the Wagner Electric Manufacturing Company, St. Louis, Mo., and Joseph H. Hunter, president of the Detroit Insulated Wire Company, Detroit, Mich. The names of the other members of the committee were given in the ELECTRICAL WORLD of April 24, 1915, page 1081.

Bureau of Standards on Electric Service

The Bureau of Standards has announced that it is preparing a circular on the subject of the standards for electric service which can be required by public service commissions or city officials from electric light and power companies serving the public. This includes the subject of the quality and safety of service and the accuracy of measurement by the instruments employed. It also deals with certain other public relations questions.

One of the clauses of the proposed set of rules being drawn up by the bureau is the following: "Lamps furnished by utilities to customers without charge (free renewals) or at prices less than open market prices should be of such efficiency in watts per candle when used on the utilities circuits of standard voltage that the cost of light per candle-power to customers will not exceed the cost per candle-power when incandescent lamps are bought in the open market."

While some companies heartily approve of this proposal, it is possible, the bureau says, that objection will be made by others, but it is believed by the bureau that when the facts with regard to the efficiency and durability of tungsten lamps at the present time are fully appreciated by commissions and companies there will be a general disposition to act in accordance with this suggestion.

"Electrical Prosperity Week" Meetings

Plans are being made for a series of "Electrical Prosperity Week" meetings in several Middle Western cities. Requests have been received by the Society for Electrical Development for such meetings to promote the celebration, and, so far as is possible, every request will be met.

Several hundred representative business men attended a meeting in Toledo on May 6, under the auspices of the Jovians, the Commerce Club and Rotary Club, to promote the movement. Messrs. J. M. Wakeman, general manager of the society, and H. W. Alexander, director of publicity, spoke of the plans for the campaign.

The annual meeting of the society will be held at the headquarters in the United Engineering Societies Building, New York, on May 11. The annual reports of the general manager and the treasurer will be presented, and an outline of the work of the society will be given by members of the staff. Stereopticon slides and motion pictures will be used to illustrate these talks. Following this meeting the directors will elect officers for the coming year.

The staff of the society is being increased to care for the increased work of the "Electrical Prosperity Week"

campaign. Two additional advertising and publicity men have been engaged.

The difference between the work of the Society for Electrical Development and the Jovian Order, as typified by the respective slogans, "All Together, All the Time, for Everything Electrical" and "Do It Electrically," was explained by Mr. J. M. Wakeman, general manager of the society, at the Jovian League luncheon held at the Martinique Hotel, New York, on May 5. Mr. Wakeman was the guest of honor and principal speaker. He spoke of the electrical prosperity movement and what it means to the electrical industry, to the country and to the Jovians. He asked the close co-operation of the Jovians in the campaign. Mr. Wakeman expressed his appreciation of the splendid co-operation of the Jovian leagues in aiding the movement up to this time, and stated that he felt assured, as did the other executives of the society, that the success of the campaign would be due largely to the Jovian order. The chairman of the day was Mr. H. G. McConnaughy, who was introduced by Mr. Frank E. Watts, tribune.

Status of Chicago's Home-Rule Controversy

Representatives of the electric-service, gas and traction interests of Chicago appeared before a sub-committee of the Illinois Legislature committee on public utilities, May 1, and opposed the home-rule proposal which Chicago's new Mayor, Mr. William Hale Thompson, had previously made before the legislative committee at Springfield, Ill.

Mr. Gilbert E. Porter, representing the electric and gas properties with which Mr. Samuel Insull is connected, complimented the work of the State Public Utilities Commission of Illinois and strenuously objected to the passage of any law vesting regulative power in the Chicago City Council. Mr. George W. Miller, representing the Chicago Surface Lines, said that he did not object to home rule, but that he did oppose the establishment of a local regulative body appointed for a short term and too responsive to public clamor.

Following the hearing, the sub-committee voted to report a bill providing for a municipal utilities commission to be appointed by the Mayor.

War Orders for Electrical Manufacturers

Large orders have been received by various companies for the manufacture of munitions of war. The principal contract which has been given publicity is one received by the Westinghouse Electric & Manufacturing Company. Although the details are not confirmed officially, Chairman Guy E. Tripp of the Westinghouse company stated on April 30 that the company had received a large order for a foreign government. Reports are that the orders taken by the company, in part at least, are for rifles and that the value is more than $50,000,000. It is reported that the Westinghouse Machine Company plant and the Westinghouse Air Brake Company are interested in the orders. Large orders are also said to have been taken by the American Locomotive Company and the Allis-Chalmers Company, although no official statement regarding them has been made.

The Westinghouse Electric & Manufacturing Company is said to have secured an option for the purchase of the property of the J. E. Stevens Arms & Tool Company of Massachusetts and the Stevens-Duryea plant, which is controlled by that company. On the strength of the reports of war orders, Westinghouse Electric & Manufacturing Company common stock has advanced to 108. General Electric Company stock has also advanced. Reports are that the profits of the Westinghouse company on the orders received will be sufficient to retire the funded debt and to assure a large earning capacity for the common stock.

A bill filed in Milwaukee courts by Mr. Samuel Pearson, who was a general in the Boer war, charges that the Allis-Chalmers Company has entered into a conspiracy with the Bethlehem Steel Company or others to ship shrapnel shells to Europe. Officials of the government are quoted as saying they do not see how the case involves a violation of federal laws or concerns the federal government unless there is something disclosed embracing some other question than the right of American manufacturers to make munitions of war and to ship them to belligerents.

Convention Plans of N. E. L. A. Commercial Section Power Sales Bureau

The first active participation of the bureau of the N. E. L. A. Commercial Section devoted to the sale of energy for motor service in a National Electric Light Association convention will take place at San Francisco on June 7 to 11. Special efforts have been made to prepare a comprehensive program in keeping with the broad scope of the work of this new division of the Commercial Section, which was formed at the Philadelphia convention in 1914.

Writing to the ELECTRICAL WORLD in regard to the plans, Mr. Charles J. Russell, of the Philadelphia Electric Company, chairman of the bureau, says:

"This work constitutes one of the most important constructive efforts of the Commercial Section of the N. E. L. A. The primary objects of the organization were to establish an acquaintance and close relationship between the motor-service men in the country, to establish a clearing house for the collection and dissemination of information and data relating to the work of selling energy for motor service, and to advance sales. A comprehensive outline for this work has been adopted and subdivided among seventeen main and twenty-nine sub-committees.

"Important work has been done toward co-operation between the bureau and other bodies engaged in similar work in order to prevent duplication of effort. From the very beginning the bureau has had the complete co-operation of the Society for Electrical Development. The committee charged with the 'education of power salesmen' is working with the Commercial Section committee. The Electric Power Club has furnished its standard specification sheets, etc., and promised its further co-operation. Steps have been taken toward securing the complete co-operation of the industrial power committee of the American Institute of Electrical Engineers. This is a matter of great importance. It seems particularly desirable, as the results would be of mutual advantage to both organizations.

"An attractive program has been arranged for the convention meetings of the bureau, and Mr. Stanley V. Walton, of San Francisco, is chairman of the committee to arrange for a 'get-together' dinner followed by a round-table discussion on appropriate topics during convention week."

Organization of the Work

In order that the bureau may cover effectively the entire subject of sales of energy for motor service the following subdivision of work has been made:

Sub-committee No. 1—Its organization and methods: (a) Constitution of bureau; (b) qualifications of men.

Sub-committee No. 2—The education of salesmen.

Sub-committee No. 3—Statistics and data. This committee will constitute the clearing house for the collection of data and information from all the subdivisions, and material so collected will be deposited at the headquarters of the Commercial Section in New York. It is expected that all inquiries for information relating to motor service will be referred to this committee for attention and reply. The first duties of this committee will be: (a) The standardization of the collection of statistics and data by members of the bureau; (b) the standardization of forms upon which such information shall be collected and preserved; (c) recommendation as to the definition of load-factors and demand measurements to be used in the collection of such standard data. Having done this, a general function will be the collection of general and specific information relating to all branches of electric motor service. This covers also the collection of monographs upon classified motor applications.

Sub-committee No. 4—Industrial motor applications under the following subdivisions: (a) General information; (b) mining, quarrying, mineral and stone products; (c) metal working; (d) woodworking; (e) textile, clothing, fibers, etc.; (f) food products; (g) leather workers, tanneries, etc.; (h) glass manufacturing; (i) ventilating, heating, water supply, sanitation, etc.; (j) ice-making and refrigeration; (k) laundries, dry cleaning, etc.; (l) hoisting, elevating, conveying, etc.; (m) public institutions, amusements, etc.; (n) office buildings, hospitals, etc.; (o) printing, publishing, bookbinding, etc.; (p) department stores; (q) chemical products; (r) paper and pulp manufacture; (s) electricity on the farm.

Sub-committee No. 5—The supply of energy for operating electric railroads and railways.

Sub-committee No. 6—Sub-surface and municipal construction.

Sub-committee No. 7—Electric vehicles.

Sub-committee No. 8—Special motor applications.

Sub-committee No. 9—Electric-heating applications other than furnaces and welding.

Sub-committee No. 10—Electric furnaces and welding.

Sub-committee No. 11—Electrochemical supply.

Sub-committee No. 12—Electrotherapeutic supply.

Sub-committee No. 13—Steam heating.

Sub-committee No. 14—Competitive sources of energy: (a) Isolated steam plants; (b) gas, oil and producer plants; (c) energy purchased with space; (d) cost of energy; (e) disposal of displaced apparatus.

Sub-committee No. 15—Relation of lighting to motor service sales.

Sub-committee No. 16—Increase of load-factor, with special reference to obtaining high load-factor and off-peak business.

Electricity in the Navy

At a regular meeting of the National Electric Light Association Section of the Edison Electric Illuminating Company of Boston on April 20, Lieut. W. K. Kilpatrick, of the United States Navy, gave an illustrated lecture on "Electricity in the Navy." In addition to a full description of familiar applications of electrical energy in lighting, power and heating service on war craft of various types, the speaker touched upon the extension of motor service to auxiliary duties on submarines, the tendencies toward multiplication of radio sending and receiving circuits on battleships, and the advantages of turbo-electric propulsion. Submarine periscopes are now turned by 0.25-hp motors.

The installation aboard a modern submarine consists of the driving motors, two shunt motors for operating circulating pumps, an electric-lighting system, small searchlight, electric heaters, telephone and call-bell systems, electric rudder indicator system, submarine signals, gyro-compass, radio outfit, signal and running lights, periscope, capstan and steering motors. Four compartments are used in the latest work, and cooking is done by electric ranges. An auxiliary lighting system equipped with 6-volt portable lamps is a feature of recent boats.

On battleships recent progress includes elaborate provision for electrical control, with general service and fire-control telephone systems, remote indication of propeller speeds, boiler temperatures, motor operation of whistle valves, electric gun firing, and multiplied radio stations and circuits. The ease of control obtainable with turbo-electric propulsion constitutes one of the strongest features of this method, which will be used on the battleship *California* as the result of experience with electric propulsion on the collier *Jupiter*.

Cleveland Municipal-Plant Developments

According to Commissioner of Light and Heat F. W. Ballard, of Cleveland, the revenue from the municipal light plant in March was $36,633. This, according to his report, is $8,024 above all expenses for that period, including interest, depreciation, deferred upkeep and administration. The total gross revenue for the first three months of the year was $111,609.

Mr. Ballard announced that the plant is prepared to sell energy to the water department for the operation of the pumps at the Fairmont station at the rate of 0.5 cent per kw-hr. The water department, however, will have to purchase motors and pumps. The energy would be used at the pumping station from 12 o'clock midnight to 6 a.m. Such a contract would amount to about $20,000 a year and would enable the light section to pay the water department the $112,000 which it owes for the land on which the light plant is situated.

Effects of War on Wireless Company

In the annual report of the Marconi Wireless Telegraph Company of America, covering the calendar year 1914, it was stated that the arrangements made for direct service between New York and London had been practically completed when the outbreak of the war forced the company's officers to set aside the vigorous campaign through which it had planned to secure a share of the transatlantic cable business. The duplex stations at Belmar, N. J., and New Brunswick, N. J., were completed and were being tested late in July when word came that the corresponding English stations at Carnarvon and Towyn, in Wales, had been commandeered by Great Britain for the use of the Admiralty. This came as a very serious blow to the company's hopes. A strong transoceanic department had been organized, and twenty-four-hour service was to have been provided through a new commercial office opened in the heart of New York's financial district.

There is small likelihood that the company will be able to continue tests or open the stations to public service until the end of the war, but when that time arrives the company expects to be reimbursed in full, claims for indemnity on losses sustained being included with those which the affiliated English Marconi company will ask from the British government.

The direct service between Boston and Norway through the transoceanic stations which were being built at Marion, Mass., and Chatham, Mass., has also

been blocked by the war. The construction work on both the stations of the company and those in Norway is almost finished, and the installation of the apparatus could have been completed before now had it not been that the equipment is being made in England. It is doubtful whether it can be delivered here or in Norway until the war is over.

While in the year ended there has been created a new source of revenue from transpacific stations, the message traffic between shore and ship has been greatly affected by the war. The revenue from ships flying the American flag has been considerably increased, but the gain thus made has not been sufficient to offset losses due to the withdrawal of so many foreign ships from American waters.

Water-Power Conference of Western States

A good deal of preliminary work has been done in connection with the proposed water-power conference of representatives of Western States. Delegates are being appointed from approximately ten Western States, and it is believed by the officials of the State of Oregon who have the plans in hand that at least this number will be represented officially. Governor Withycombe of Oregon will announce the date for the conference in a short time. Presumably it will be early in September.

Water-Power Legislation

Secretary Lane of the Interior Department has announced in Washington that the water-power leasing bill which was passed by the House of Representatives but which failed in the Senate at the last session of Congress would be introduced immediately upon the reconvening of Congress. The necessity for such legislation, Secretary Lane said, is shown by the rumor of consolidation of water-power companies in Colorado, Utah, Montana and Washington. If this consolidation is fully consummated, he said, it would place under corporate control about 50 per cent of the developed water-power of the Western States.

Mr. Brandeis Consulted by Federal Trade Commission

Mr. Louis D. Brandeis, of Boston, who brought about the New York, New Haven & Hartford Railroad investigation and contested the application of the railroads for permission to increase freight rates, is being consulted by the Federal Trade Commission. He was invited to appear before the commission and suggest rules of procedure.

The commission is also consulting Mr. Arthur J. Eddy, an attorney and student of the subject of unfair competition, who requested an opportunity to express his views and learn the views of the commission.

A number of reports are to be issued soon from the office of the Federal Trade Commission, based in large part on information compiled under the old Bureau of Corporations and on data gathered by Mr. Joseph E. Davies personally when he was assisting committees of Congress in preparing material on which the new anti-trust legislation was based.

Of these reports one on the farm machinery trade was the first. There are five others. One report is expected to be of particular value in connection with the discussion as to whether American firms and corporations engaged in export trade shall be permitted to have common selling agencies as do manufacturers and producers in European countries.

The reports are the results of investigations of oil fields, the tobacco industry, state corporation taxation laws, as well as a compilation and digest of corporation laws of all the states and a compilation and digest of trust laws and legislation in various countries.

For instance, Australia has a trade commission similar in some ways to the Federal Trade Commission. The report will analyze that commission's powers and duties. In addition, there will be an explanation of the laws on monopoly in New Zealand, South Africa and European countries, such as England, France, Germany and the Balkan States. When Mr. Davies was working with the House and Senate committees which prepared the anti-trust legislation he wrote a number of briefs and compiled data on trust laws of foreign countries which the commission believes will be useful. This report will contain English and American decisions on unfair practices and price competition.

A large number of complaints have reached the commission as to price discrimination and unfair practices in the United States. The commission believes that fully one-half of these can be adjusted informally without hearings.

Mr. Dahl on the Idaho Merger

The consolidation of the Idaho-Oregon Light & Power Company, the Idaho Railway, Light & Power Company and the Idaho Power & Light Company has been consummated. Negotiations are pending to include in the merger the Great Shoshone & Twin Falls Water Power Company and the Southern Idaho Water Power Company. The new company, known temporarily as the National Securities Corporation, was organized under the laws of Virginia. This company will hold only the securities, and a new company of a more local nature will be organized with local directors. This program was laid before the Public Utilities Commission of Idaho, at its hearing to investigate the merger, by Mr. G. M. Dahl, of New York, president of the National Securities Corporation and vice-president of the Electric Bond & Share Company.

The merger of the large southern Idaho hydroelectric companies, Mr. Dahl testified, would result in better service and a more rapid development of new electrical fields. It does not include the Utah Power & Light Company or any other hydroelectric companies in Utah, Montana or Colorado. Mr. Dahl said that the Electric Bond & Share Company does not control the National Securities Corporation but is a very small minority stockholder. The corporation has between 600 and 700 stockholders and has $21,000,000 stock, $10,000,000 debentures and $10,000,000 income bonds.

It was in December, 1913, Mr. Dahl said, that his people first became interested, and in the following April the National Securities Corporation was organized. The witness then said that the Idaho railway company was the owner of bonds in both of the other two competing companies, and that a deal had been agreed upon by which holdings of the Idaho Power & Light Company were to be acquired. Part of the purchase price was paid, and the National Securities Corporation now stands as having fulfilled this contract. Mr. Dahl said that it was realized that if the fight continued among the operating companies it would result only in further demoralization. After coming into control of the Idaho Power & Light Company, the new interests, the witness testified, inherited the fights which that company had been carrying on with the Great Shoshone & Twin Falls Company, particularly the one over the Malad River site. The Utah Power & Light Company is not to be included in the new consolidation, Mr. Dahl said.

Miscellaneous News Notes

Fire in Central-Station Office Building.—The office building in which the Ottumwa (Ia.) Railway & Light Company had its offices was destroyed by fire early in the morning of April 22. The company's property was fully insured and all important records were saved. Temporary offices were secured immediately, and the business of the company has proceeded with very little interruption.

New Submarine to Be Christened by Mr. Edison's Daughter.—Mrs. Madeline Edison Sloane, only daughter of Mr. Thomas A. Edison, has accepted the invitation of the Hon. Josephus Daniels, Secretary of the Navy, to act as sponsor for the new submarine boat "L-8," now in course of construction at Portsmouth, N. H. This vessel will be the first submarine to be equipped with the new Edison battery.

New Navy Wireless Stations for Pacific Coast.—The Navy Department is planning to construct a new high-power radio station on Puget Sound, probably at Keyport, near Bremerton, Wash. The plant will be one of the most modern stations ever built, and will have towers 400 ft. high. It is also reported that another wireless station will be erected on the Copper River Flats at Cordova, Alaska.

Electric Vehicles in Chicago Prosperity Parade.—Two hundred electric pleasure cars and seventy-five electric trucks formed a part of the "prosperity parade" which welcomed Mayor William Hale Thompson of Chicago to office. Through a co-operative arrangement among local pleasure-car dealers and manufacturers 50 cents was paid by them to a charitable organization for each electric pleasure car in the parade.

Philadelphia Suburban Electrification in Operation June 1.—Following the successful tests that have been made on the newly electrified line of the Pennsylvania Railroad between Philadelphia and Bryn Mawr, similar trials will be conducted over the division from Overbrook to Devon. During the latter tests an effort will be made to perfect a running schedule for trains. The entire electrified system is to be in operation by June 1.

Robins Again Make Nest in Choke Coil.—Robins have again made their nest in a 60,000-volt choke coil at one of the stations of the Rochester (N. Y.) Railway & Light Company. The employees of the station declare that the female is the same that has nested in the dangerous hollow of the coil for many seasons. The male bird was killed last year by coming into contact with the wires, but was soon succeeded by another who assisted the female in building a second nest in which a family of young robins was safely reared.

Utility Bureau Urged for Philadelphia.—Mr. Judson C. Dickerman, chief of the Bureau of Gas of the city of Philadelphia, has issued a report urging the organization of a public utility bureau. He declares that the Philadelphia Electric Company is selling electrical energy to the Pennsylvania Railroad and the Philadelphia Rapid Transit Company cheaper than similar concerns anywhere else, and that either the company is selling its products foolishly and illegally to railways at low cost or it is greatly overcharging the rest of its customers.

Columbus Cannot Issue Bonds for Light-Plant Deficit.—City Solicitor Scarlett, of Columbus, Ohio, has rendered an opinion to Director of Public Service Borden to the effect that the City Council has no authority to issue bonds to meet a deficiency in the operating expenses of the municipal light plant. A request had been made for legislation to obtain $10,000 to overcome a shortage in the light-plant funds. Director Borden said that the Council had cut the appropriation for the light plant $9,000, and this, he says, is the cause of the anticipated deficit.

Catskill Aqueduct Franchise.—Mayor Mitchel of New York has been authorized by the Board of Estimate and Apportionment to sign a contract granting a franchise to the New York Edison Company and other subsidiaries of the Consolidated Gas Company to construct and maintain transmission towers and poles over the Catskill aqueduct for the purpose of supplying electrical energy. The contract is for twenty-five years. In payment therefor the lessees will give the city without cost electrical energy for working, lighting and pumping siphons along the aqueduct route. President Strauss of the Board of Water Supply said that the city must have electrical energy. It would either have to build a plant at a cost of not less than $520,000 for construction and not less than $73,000 per year for operation and maintenance, buy energy at a cost of $66,600 a year for twenty-five years, or grant the franchise.

New Home of Safety Museum.—The new home of the American Museum of Safety at 16 and 18 West Twenty-fourth Street, New York, was opened on May 4. An exhibit of safety devices used in an electrical central station is in one of the windows facing the street. President Arthur Williams, in an address welcoming visitors, said that it is the intention to come into closer contact with industrial workers. For such a plan the new location is more suitable than the old one because it establishes the museum literally on the ground floor. This, it is hoped, will lead passers-by who are attracted by the window displays to step inside. It will also be more convenient to give lectures illustrated with stereopticon and moving pictures. A series of such lectures is being prepared.

Farewell Dinner to Mr. Tait at Dayton.—Following is the list of speakers at the dinner to be tendered Mr. Frank M. Tait, president of the Dayton Power & Light Company, May 11, under the auspices of the Dayton Jovian League, on the occasion of Mr. Tait's departure for New York City to engage in executive work there, as already noted in these columns: Mr. H. H. Scott, president National Electric Light Association; Mr. Paul M. Lincoln, president American Institute of Electrical Engineers; Mr. C. V. Hard, president Ohio Electric Light Association; Mr. Homer E. Niesz, Jupiter of the Jovian Order; Mr. Henry M. Waite, general manager of the city of Dayton; Mr. Fred H. Rike, president Greater Dayton Association; Mr. Edward A. Deeds, president Engineers' Club of Dayton; Hon. James M. Cox, ex-Governor of Ohio, and Mr. Charles Wuichet, director Dayton Power & Light Company. Mr. D. L. Gaskill, president of the Greenville Electric Light & Power Company, Greenville, Ohio, will act as toastmaster.

Overhead Power Crossing Specifications.—The national joint committee on overhead and underground line construction has appointed the following sub-committees to handle the work of revision of the specifications: Structural—Messrs. F. L. Rhodes (chairman), G. A. Harwood, R. J. McClelland, R. D. Coombs and J. H. Davis; insulation—Messrs. W. J. Eck (chairman), Percy Thomas, F. B. H. Paine, R. E. Chetwood, E. B. Katté and A. S. Richey; conductors—Messrs. Paul Spencer (chairman), Thomas Sproule, George Cellar, W. I. Capen, R. J. McClelland and H. T. Wreaks; clearances—Messrs. C. L. Cadle (chairman), G. F. Sever, W. J. Canada, L. S. Wells, H. S. Warren and E. B. Katté. Circular letters have been issued to operating companies, tower manufacturers, consulting engineers and others requesting data and replies to a series of questions. The committee particularly invites suggestions for specific clauses or paragraphs to be added to or changed in the existing specifications. Mr. R. D. Coombs, 30 Church Street, New York City, is secretary of the national joint committee on overhead and underground construction.

Pending Legislation in Ohio.—Senator Horn's bill repealing the law which requires that municipalities purchase private light plants before they can erect and operate municipal plants was defeated in the Ohio Senate by a vote of nine to twenty on April 29. After having defeated the Stone bill in the forenoon on April 27, the Senate reconsidered and passed the measure later in the day. This bill places municipally owned public utilities under the jurisdiction of the Public Utilities Commission on the same basis as private properties, including service and rates. The Myers bill, defining what shall enter into the cost of service by municipal plants, was recommended for passage by the public utilities committee of the Senate. The Behne bill, regulating the issue of bonds for the purchase or construction of public utility plants by municipalities, was recommended for passage by the House committee on public utilities on April 27. It will be placed upon the calendar when the time appears to be favorable for consideration. When the Reighard bill came up in the House for concurrence on amendments, a contest was made against it. It provides that the valuation of public utilities shall be optional with the commission instead of mandatory.

Associations and Societies

Meeting of Electrical Manufacturers' Club.—The Electrical Manufacturers' Club met at The Homestead, Hot Springs, Va., from May 4 to 8. Matters affecting internal policies of the club were considered.

A. S. C. E. Meeting.—At a meeting of the American Society of Civil Engineers to be held May 15 at the society's rooms, 220 West Fifty-seventh Street, New York, Mr. J. D. Galloway will present a paper on "The Design of Hydroelectric Power Plants."

Cincinnati Display Men Hear Lecture on Store Lighting.—At a meeting of the Cincinnati Association of Display Men, April 22, Mr. A. J. Edgell, of the Society for Electrical Development, gave an illustrated lecture on store lighting, presenting a study of illumination as an adjunct of merchandising.

Los Angeles Jovians Hear Talk on Efficiency.—At the April meeting of the Los Angeles (Cal.) Jovian League Mr. S. M. Kennedy, general agent for the Southern California Edison Company, delivered an address on personal efficiency. The speaker emphasized the necessity of combining confidence, capacity and courtesy.

Utah Society of Engineers.—Mr. S. C. Arentz was elected president of the Utah Society of Engineers at the society's annual meeting, held at Salt Lake City in April. Mr. C. J. Ulrich was chosen secretary. The society now has 152 members, according to the report of Mr. Frank W. Moore, retiring secretary. Mr. C. P. Overfield acted as toastmaster at the annual dinner.

St. Louis Electrical League Holds Ladies' Day.—The St. Louis Jovian League of Electrical Interests' second ladies' luncheon, held on April 27, was attended by 76 ladies and 145 members. Mrs. William H. Utter, president of the St. Louis Women's Council, spoke on "The Proposed Parkway." Other speakers of the afternoon were Messrs. Herman Spoehrer and Ell C. Bennett.

Adams (Mass.) Service Club.—At the April 27 meeting of the Service Club, which is composed of employees of the Williamstown, Adams and North Adams public-service companies, Mr. John J. Quinn, secretary of the employees' association of the Pittsfield Coal Gas Company, gave a talk on public service associations. The May meeting of the club will be a question-box session.

Fulton County (N. Y.) Gas & Electric Employees.—The final meeting for the season of the employees of the Fulton County Gas & Electric Company was held April 20 at the company's offices at Gloversville, N. Y. Mr. Adrian Tobias, of the Westinghouse Electric & Manufacturing Company, addressed the meeting on "Electric Meters." The organization will not meet again until October.

Pittsburgh Section, E. V. A.—At the April meeting of the Pittsburgh Section of the Electric Vehicle Association of America, held April 29, in the Dutch room of the Fort Pitt Hotel, the usual dinner was followed by the motion-picture film "Selling Electrical Vehicles." Mr. F. B. Fink, of Philadelphia, was the principal speaker of the evening and addressed the section on "Transportation Problems," emphasizing the advantages of the electric vehicle.

Erie (Pa.) Jovians Inaugurate Saturday Half Holiday.—Members of the Jovian Order at Erie, Pa., have agreed to institute Saturday afternoon closing in all stores and offices controlled by local Jovians. The new closing schedule will be enforced from June 1 to Oct. 1. At the Erie Jovians' meeting of April 26, held at the Reed House, Mr. E. C. Corrigan, vice-president of the National Metal Molding Company, spoke on "Concentric Wiring." A big rejuvenation is planned for Erie Jovians in June.

Cincinnati Electrical League.—On April 26 more than seventy-five members of the Cincinnati Electrical League were present at a dinner at the Gibson House. Mr. W. W. Freeman, president of the Cincinnati Gas & Electric Company, presided. Mr. W. C. Culkins, of the Chamber of Commerce, was the principal speaker. He urged that the organization affiliate with the activities of the chamber. Prof. A. L. Wilson, of the University of Cincinnati, and Mr. J. S. Rickard, of New York, made brief addresses. The league members promised to promote the organization and increase its membership.

Indianapolis Jovians Encourage Boy Scout Movement.—The Indianapolis (Ind.) Jovian League has pledged its assistance to the local campaign for the benefit of the Boy Scout movement. Mr. E. Laurence Eddy, of Baltimore, Md., who has been in Indianapolis organizing the movement, spoke at an April meeting of the league The suggestion has been made that the Indianapolis Jovians pay the expenses of ten boys to a convention of the Boy Scouts in Indiana.

West Virginia Utilities Organize.—A temporary organization of representatives of public utility companies of West Virginia was effected at a meeting at Huntington on April 26, when the following officers were chosen: President, Mr. Herbert Markle, Appalachian Power Company, Bluefield; vice-president, Mr. G. O. Nagle, Wheeling Traction Company, Wheeling; secretary-treasurer, Mr. W. C. Davison, Charleston. The first annual meeting will be held at Charleston on June 8 and 9, when permanent officers will be elected.

Springfield (Mass.) Electric Club Hears Mr. Gibbs.—"Co-operation and Its Value" was the subject of an address delivered April 26 by Mr. Louis D. Gibbs, president of the New England Section of the National Electric Light Association, before the members of the newly organized Springfield (Mass.) Electric Club. Mr. Kurt R. Sternberg, president of the club, acted as toastmaster. Short talks were also given by Messrs. Fred W. Lumis, building commissioner, and A. J. Newell, of the R. T. Oakes Company, Holyoke. The new electric club will meet for dinner on the third Monday of each month.

Western Society of Engineers.—Although the State Public Utilities Commission of Illinois actually earns more money for the State than it spends, it has had to practice most rigid economy to carry out its work, said Mr. Walter A. Shaw, a member of the commission, before the Western Society of Engineers at Chicago on May 3. Since the commission has been in operation the commission has collected and paid to the State's Treasurer fees amounting to about $670,000. The total expense of the commission has been $270,000 and about 3000 docket cases have been handled. Much of the time of the commission and its engineering staff is taken up in attending to complaints of individual citizens. As soon as more funds are made available by the Legislature, said Mr. Shaw, the engineering staff of the commission will be enlarged and the scope of its work increased.

Michigan Section, N. E. L. A., Convention Cruise.—The 1915 convention of the Michigan Electric Light Association, which is now a state section of the National Electric Light Association, will be held on board the steamship *Rochester* during a cruise on Lakes Huron, Superior and Michigan, June 26 to 30. The vessel will leave Detroit at 1 p. m. Saturday, June 26, and proceed up Lake Huron to Sault Ste. Marie, passing through the locks into Lake Superior about midnight Sunday. Monday morning will be spent in cruising along the north shore of the lake, returning to the "Soo" at noon and reaching Mackinac Island Monday night. Tuesday will be occupied with the passage down Green Bay, entering Lake Michigan at noon through the Sturgeon Bay ship canal. The party will disembark in Lake Kalamazoo next day, making a total trip of 1000 miles. The fare for the cruise will be $27.50. Mr. Herbert Silvester, Detroit Edison Company, Detroit, Mich., is secretary of the section.

Electric Association of Oklahoma.—In the program for the fourth annual convention of the Gas, Electric & Street Railway Association of Oklahoma, which is to be held at Oklahoma City May 12, 13 and 14, there are announced the following papers of interest to operators of electric-service properties: Address of the president, Mr. George W. Knox, of Oklahoma City; "The Modern Generating Station," by Mr. A. L. Mullergren, of Oklahoma City; "Utility Appraisal Under Order No. 774," by Mr. George B. Saunders, of Oklahoma City; "Analysis of Rates of Gas and Electric Utilities in Oklahoma," by Messrs. R. W. Stinson and Homer Livergood, of Norman; "Relative Values of Coal, Oil and Gas as Fuels for the Production of Electricity," by Messrs. E. E. Hunter and L. G. Purtee, of Oklahoma City; "Care and Sale of Supplies and Energy-Consuming Devices by Public Service Companies," by Mr. Galen Crow, of Oklahoma City, and "Public Utilities and Their Customers," by Mr. N. R. Gascho, of Alva.

National Fire Protection Meeting.—The nineteenth annual meeting of the National Fire Protection Association will be held at the Hotel Astor, New York, on May 11, 12 and 13. The report of the electrical committee will be presented at the morning session on May 11. At the afternoon session of the same day Mr. James E. Latta will speak on the Underwriters' Laboratories, Inc., and its work. The association has issued a circular outlining the measures which it advocates in its warfare against needless loss by fire.

Program of Ohio E. L. A. Convention.—The annual convention of the Ohio Electric Light Association will be held at Cedar Point, Ohio, July 20 to 24 inclusive. Following President C. V. Hard's address and other official reports, Mr. S. E. Doane, Cleveland, will present the report of the illumination committee, Mr. M. H. Wagner, Dayton, the report of the distribution and transmission committee; Mr. A. H. Bryant, Cleveland, the report of the meter committee; Mr. C. W. Chappelle, Cleveland, the report of the electric-vehicle committee, and Mr. T. F. Kelly, Dayton, the report of the committee on new-business co-operation. Among the papers to be presented are those on "Everyday Problems Confronting the Central-Station Manager," by Mr. E. J. Bechtel, New York City, and on "Publicity for Central Stations," by Mr. E. B. Fenton, Sandusky. Mr. R. H. Grant, sales manager of the National Cash Register Company, Dayton, will also deliver an address. Mr. D. L. Gaskill, Greenville, Ohio, is secretary of the association.

Motor-Truck Convention at Detroit.—A large attendance of motor-truck manufacturers, engineers and sales managers opened the motor-truck convention held at the Statler Hotel, Detroit, Mich., May 5 and 6, under the auspices of the National Automobile Chamber of Commerce. The program was arranged under the direction of the commercial vehicle committee, consisting of Mr. W. T. White, chairman, and Messrs. Alvan Macauley, P. D. Wagoner, H. Kerr Thomas and M. L. Pulcher. Among the papers of particular interest to electric-vehicle men was one on "Why Service Conditions Should Be Investigated and Recommendations Made Before Selling a Customer," by Mr. Vernon Munroe, president International Motor Company. Discussion on this paper was to be led by Mr. W. P. Kennedy, consulting engineer, New York City; Mr. F. C. Lindoefer, Atterbury Motor Car Company, and Mr. H. H. Rice, vice-president Waverley Motor Car Company. At the Thursday afternoon session Mr. P. D. Wagoner, president of the General Vehicle Company, Long Island City, N. Y., presented a paper on "The Future of the Electric Truck." Mr. A. C. Downing, sales manager of the Anderson Electric Car Company, Detroit, was to lead the discussion, followed by Mr. E. J. Bartlett, manager of the truck department of the Baker Motor Vehicle Company, Cleveland, Ohio.

Mr. Gilchrist on Popularizing the Electric Vehicle.—Mr. John F. Gilchrist, vice-president of the Commonwealth Edison Company and president of the Electric Vehicle Association of America, addressed a joint meeting of the Electric Club of Chicago, the Chicago Section of the Electric Vehicle Association and the Chicago Jovian League on April 22, on the subject of "The Electric Vehicle." The main argument at present used against electric cars, said Mr. Gilchrist, is that they will not go fast enough or far enough. The public hearkens to this argument because automobiles at present are used mainly for pleasure. They are the playthings of "joy riders." Within the next ten years, predicted the speaker, horses will have entirely disappeared from the city streets, and then the electric car, which can go far enough and fast enough for all commercial purposes, will come into its own. The present income to central stations from electric-vehicle business is not larger, declared Mr. Gilchrist, only because central stations have not elected to assume their share of the expense of introducing the vehicles. Stations in smaller cities, although perhaps the most vitally interested, have neglected the vehicle business even more than the larger plants. In consequence vehicle manufacturers have made no money and probably will make none until selling costs are reduced. As a method of popularizing the "electric" Mr. Gilchrist suggested that snappy stories, such as are told about Ford cars, be circulated regarding electric vehicles. To give this story campaign a start he told of a friend who had dubbed his electric car a "deaf and dumb wagon," to convey the idea of its silent operation.

Public Service Commission News

Pennsylvania Commission

An investigation into the efficiency of various types of electric lamps used for street lighting has been ordered by the commission for the information of municipalities. Information will be secured on the cost of installation, operation and renewals. Details as to illumination at various distances will also be obtained.

New York Commissions

The New York Edison Company and the United Electric Light & Power Company have been authorized by the First District commission to postpone for thirty days from May 1 the sub-meter provisions of the new tariff, which went into effect on that date. These provisions require the maintenance of only one meter for large buildings. In case the landlord desires to install sub-meters for different apartments such meters shall be put in at his expense. The stay is granted to allow the companies sufficient time for changing meters, etc. This action does not affect the rest of the new tariff.

California Commission

The Supreme Court of California has rendered a decision denying the application of Mr. L. Ghriest, proprietor of the Newport Beach Electric Light & Power Company, for a writ of review in the matter of a decision rendered by the commission in which the Pacific Light & Power Corporation was authorized to operate in the city of Newport Beach. The Supreme Court refers to the case of the Pacific Telephone & Telegraph Company versus Eshleman et al., and holds that, in accordance with the views therein expressed, the application should be denied.

The commission has issued an order at the request of the Pacific Gas & Electric Company dismissing its application for authority to establish new tariffs for motor service in all territory in which the commission now has the power to make rates.

Governor Johnson has signed the bill giving authority to the commission to regulate rates of all public utilities except municipally owned properties. The bill goes into effect ninety days after the adjournment of the Legislature.

Massachusetts Commission

The Gas and Electric Light Commission has authorized the municipal light board of the town of Rowley to sell electrical energy at a net rate of 12.5 cents per kw-hr., alleged to be less than cost as defined by statute. The town owns a public distributing plant which has been operated since 1910, energy being sold at a net rate of 15 cents. The energy has been purchased from the municipal plant at Ipswich at an average rate of 6 cents per kw-hr. More favorable terms are expected in the early renewal of the contract, in view of the possibility of increasing the motor-service load. The 12.5-cent rate is admittedly below cost (which includes all operating expenses, interest on the plant investment, sinking-fund requirements, depreciation at not less than 3 per cent, and losses), but was established by the municipal light board after consideration by the town meeting and a favorable vote.

The commission points out that the foregoing method of determining cost is somewhat arbitrary and artificial and gives little consideration to the assumption of such risks as may be reasonably necessary to develop the business. It calls attention to the fact that an increase in output which involves no corresponding increase in investment may result in a lower average unit cost and be closely related to the rate for energy. While it is convinced that it would be unsound for the town to adopt a policy of selling energy permanently at a loss, the board "is not disposed to withhold its consent from the taking by the management of what seems no more than a reasonable business risk. The new price must, of course, be regarded as experimental, to be abandoned later if a reasonable experience under it demonstrates that energy will thereby be sold at a loss." The commission emphasized the importance of a definite charge by the lighting department for service rendered to municipal buildings.

Personal

Mr. I. W. Morris has been elected treasurer of the United Gas Improvement Company of Philadelphia.

Mr. W. M. Case has been appointed manager of the municipal water and lighting plant at Humboldt, Tenn.

Mr. Elmer Lingard has resigned as superintendent of the East Norwalk (Conn.) municipal electric-lighting plant.

Mr. T. J. Condon has been appointed superintendent of works for the Champaign (Ill.) Railway, Gas & Electric Company.

Mr. J. A. Shaw has been appointed general electrical engineer of the Canadian Pacific Railroad with offices at Montreal, Quebec.

Mr. A. M. Plummer, formerly a member of the staff of the Atlantic City (N. J.) Electric Company, has been appointed local manager of the Ocean City (N. J.) Electric Light Company.

Mr. H. S. Collette, secretary of J. G. White & Company, Inc., and the J. G. White Engineering Corporation, has resigned from these companies. Mr. Collette expects to reside permanently in California.

Mr. Paul Leake, who was formerly publicity manager for the American Utilities Company, Grand Rapids, Mich., has resigned and accepted a position as advertising manager of the Michigan Trust Company, Grand Rapids.

Mr. Edward F. Strong, for the last twelve years superintendent of the city electric-lighting plant at Chaska, Minn., has become manager of the newly organized Waconia Light & Power Company, of Waconia, Wis., for which a franchise has been granted himself and Mr. R. F. Strong.

Mr. Charles G. M. Thomas, president of the New York & Queens Electric Light & Power Company, has been elected president of the Chamber of Commerce of the borough of Queens. The chamber has appointed a constitutional convention committee, of which Mr. Thomas is a member.

Dr. Alexander Graham Bell, of Washington, D. C., has accepted an appointment as one of the hundred electors of the Hall of Fame, New York City, who will this year select the names of thirty-four distinguished Americans whose memory is to be perpetuated by bronze tablets in the colonnades of the Hall of Fame.

Mr. H. R. Wilbur has resigned as manager of the Union Electric Light & Power Company, Franklin, Mass., effective June 30. Mr. Wilbur was formerly connected with the Plymouth Electric Light Company, and was appointed manager of the Franklin company in January, 1912. He is a graduate of the Massachusetts Institute of Technology.

Mr. R. E. Breed, president of the American Gas & Electric Company, is reported to be well on the road to recovery, following his recent accident. While visiting some gold-mining properties at Phenix, Ariz., Mr. Breed fell, striking his chin in such a way as to cause a concussion of the brain. Soon after the accident he was taken to Chicago, and recent bulletins from his bedside pronounce him now well out of danger.

Mr. O. L. Remington, general manager of William McLean & Company, Melbourne, Australia, engineers, manufacturers and importers, is visiting the United States in company with the firm's engineer, Mr. H. P. McColl, to study electrical methods and machinery in this country. Their headquarters will be at the Hotel LaSalle, Chicago, for a week or two, after which Eastern industrial centers will be visited, before returning home by way of England.

Lieut. Bryson R. Bruce, a graduate of Annapolis, who last year completed a post-graduate course in the graduate engineering school of Columbia University, has been appointed chief engineer in charge of the collier *Jupiter*, the first electrically propelled ship used by the navy. The success of recent tests on the *Jupiter* has induced the government to install similar electrical propulsion apparatus in the new battleship *California*, as already noted in these columns.

Mr. Clinton White, of the Massachusetts Public Service Commission, will retire from the board on May 18, when he will reach the age of seventy. Mr. White was appointed a member of the Massachusetts Railroad Commission in 1901 and has borne an important part in the work of the board and its successor, the Public Service Commission, particularly in the consideration of financial matters. He is the senior member of the board and is widely known in the public utility field.

Mr. W. S. Hays has joined the staff of the McGraw Publishing Company to undertake special sales-promotion work for the ELECTRICAL WORLD and the *Electric Railway Journal*. Mr. Hays comes directly from the commercial department of the Union Gas & Electric Company of Cincinnati, with which he has been associated since the merging with the Ohio Service Company of the New Midland Power & Traction Company of Cambridge, Ohio, where he was formerly superintendent and local manager.

Mr. O. S. More, who for the last five years has been chief engineer of the Fairbanks-Morse Electric Manufacturing Company, Indianapolis, Ind., in charge of electrical and mechanical design, has resigned from that position to establish the More Electric Company, with offices in the Gas and Electric Building, Denver, Col. For five years prior to his connection with the Fairbanks-Morse company Mr. More served the Western Electric Company at Hawthorne, Ill., in the capacity of designing engineer, specializing on alternating-current machinery.

Mr. Halford Erickson, who is now chairman of the Railroad Commission of Wisconsin, is the only member of the commission who has served continuously since it was established in 1905, and the enviable reputation which this commission enjoys is due in no small measure to the efficient and untiring efforts of its present chairman. Mr. Erickson was born and received his early education in Sweden and came to the United States in 1884. After taking his academic training in Minneapolis, Minn., he entered the service of the Chicago, St. Paul, Minneapolis & Omaha Railroad in 1890. He served the company in various capacities until he was appointed Labor Commissioner of Wisconsin in 1896. He held this position until 1905, when he was appointed a member of the first Railroad Commission of Wisconsin by Governor La Follette. Mr. Erickson has been an earnest student of economic and financial problems, and his analyses of costs of properties and of service have done much to make the work of the commission notable among the regulating authorities of the country.

HALFORD ERICKSON

Obituary

George L. Bauldry, for the last ten years chief engineer of the plant of Walter Baker & Company, Dorchester, Mass., and active in local engineering and civic affairs, died May 4 at his home in Milton, Mass.

Gerrit Smith, inventor of quadruplex telegraphy, died at Amityville, Long Island, N. Y., May 4, following a month's illness. Mr. Smith was for fifty-four years in the employ of the Western Union Telegraph Company and retired on a pension ten years ago.

William H. Bancroft, who had been until February of this year president of the Utah Light & Railway Company, died on April 23, death resulting from a stroke of apoplexy. About a year ago Mr. Bancroft retired as vice-president and general manager of the Oregon Short Line Railroad Company, a position which he had held for twenty-three years. When the late E. H. Harriman acquired control of the Utah Light & Railway Company about eight years ago Mr. Bancroft was assigned to the responsible position of president of the company, and upon him devolved the important work of rehabilitating the street-railway and lighting and power system of Salt Lake City.

Corporate and Financial

Allis-Chalmers Manufacturing Company, Milwaukee, Wis.—Holders of voting-trust certificates for preferred stock and common stock have received a circular from the voting trustees recommending approval of the contract entered into between the reorganization committee of the company and Mr. Otto H. Falk, the president, Oct. 1, 1913, whereby there was given to Mr. Falk and his associate members of the executive committee an option to purchase on or before Oct. 1, 1915, 6505 shares of preferred stock and 2292 shares of common stock of the company for the aggregate sum of $406,136 plus interest thereon at the rate of 5 per cent per annum from Oct. 1, 1913, until date of payment. Under the terms of the contract approval thereof by a majority of the holders of the voting-trust certificates for both classes of stock is necessary before the stock can be delivered, if the option is exercised. In his annual report for the year ended Dec. 31, 1914, Mr. Falk stated that the decline in volume of business which was noted in the report of last year began in August, 1913, continued during the early part of 1914, and became more pronounced upon the breaking out of the European war. This contraction of business particularly affected the larger products of the company and rendered necessary reductions in the operating force. Most rigid economy has been exercised in all departments, and great savings have been effected until the company's manufacturing costs are now lower than ever before; but the decreased amount of business and the lower prices, due to very keen competition, more than offset all gains realized by these efforts. Notwithstanding the decreased operations during the year, the full charges for reserves and depreciation have been maintained and included in operating expenses. The expenditure of $477,495 for maintenance, repairs and upkeep has kept all the plants and equipment in good condition. In addition, the sum of $381,381 for general depreciation of the property has been charged to the operating expenses of the year. The expenditure of $222,597 for standard development, charged to cost of manufacture, was partly to improve and enlarge the present lines of manufacture and partly to complete the development of new lines which are now about ready to be put upon the market. During the year $1,745,263 was invested in marketable securities, making the total investment in marketable securities on Dec. 31, 1914, $3,607,301. The unfilled orders on hand Dec. 31, 1914, amounted to $2,503,937. The profit loss account for the year is as follows:

Sales billed		$10,323,150
Cost, including depreciation and development expenditures		9,221,174
Factory profit		$1,101,976
Selling publicity, administrative and general expenses		1,379,685
Manufacturing loss		$277,709
Other income:		
Interest on investments and bank balances, discounts, etc. (net)		252,641
Net loss for the year		$25,068

Athens (Ohio) Electric Company.—The company has been authorized by the Ohio Public Utilities Commission to issue $75,000 common stock and $75,000 in three-year 7 per cent notes. The stock is to be sold at par. One-third of the proceeds will be used to make an initial payment on the telephone plant in Athens, which the corporation is purchasing, while the balance will be expended on improvements and betterments.

City Electric Company, San Francisco, Cal.—The California Railroad Commission has issued an order approving a supplemental indenture between the company and the Anglo-California Trust Company under date of April 15, 1915. This supplemental indenture, which secures the City Electric Company's first mortgage 5 per cent thirty-year sinking fund gold bonds, includes, among other things, the guarantee of bonds as to principal and interest by the Great Western Power Company.

Commonwealth Edison Company, Chicago, Ill.—The issue of $8,000,000 of first mortgage 5 per cent gold bonds of the company which was sold recently was offered to investors at par.

Consolidated Gas Company, New York, N. Y.—In addition to the regular quarterly dividend of 1½ per cent the company has declared an extra dividend of one-quarter of 1 per cent, payable on June 15, thereby placing the stock on a 7 per cent basis. Mr. George B. Cortelyou, the president, said: "If, as many recent decisions indicate, the rate of 8 per cent per annum on capital invested in public utilities is deemed fair and reasonable, then the stockholders of the Consolidated company are entitled to recover the difference between that rate and the rate actually paid since June, 1906, inclusive, which amounts in the aggregate to 27 per cent, against which would be credited the extra dividend of one-fourth of 1 per cent about to be paid. The value placed upon the assets of the company by the United States court in the 80-cent gas case exceeded the value at which they were carried on the company's books to the extent of over $15,000,000. Obviously, therefore, the company is undercapitalized, and therefore a 7 per cent dividend on its outstanding capital stock amounts to a much lower rate of return than 7 per cent upon the actual value of its properties. It will probably be a surprise to many to know that more than three-quarters of the dividend of the Consolidated company is derived from its investments in other gas companies and in electric companies, and that less than a quarter of it is derived from its own gas business."

Dayton (Ohio) Power & Light Company.—Reports are current in Dayton that a holding company is being organized to acquire the public utility interests of that city, including the Dayton Power & Light Company, a majority of the stock of which is owned by the A. N. Brady estate. A meeting of the railway men took place on April 30 to discuss the proposition. It is said that officers of the American Railways Company of Philadelphia are promoting the consolidation, and that all of the companies are reported favorable to the plan, with the exception of the Oakwood Street Railway Company. A proposition made some time ago failed to materialize because of the opposition of this company.

Idaho Railway, Light & Power Company, Boise, Idaho.—Judge Dietrich, of the Federal District Court, has ordered that the property be sold at a date in June to be announced later. Mr. O. G. F. Markhus, receiver of the company, was appointed special master in chancery to sell the property. Interest was defaulted on the first and refunding mortgage bonds in 1914. After the Guaranty Trust Company, trustee under the bond issue, started a suit for foreclosure Mr. E. J. Jennings brought in a cross complaint on a claim of $180,000 against the property formerly owned by the Boise Railroad Company. This claim was recognized by the court, and the property to be sold will be held subject to it.

Kansas City (Mo.) Railway & Light Company.—In the suit of the company against the Metropolitan Street Railway Company and others, Judge William C. Hook, of the United States District Court, stated that he would be inclined to allow the payment of interest if within two weeks there was a strong likelihood of reorganization of the electric railway properties along lines he had clearly defined. Among other things, the Kansas City Electric Light Company must take care of a fair and equitable portion of the indebtedness, and the railway company must be so bonded as to leave a margin of safety and not endanger ability to raise capital in the future. The adjustments of the interrelations of the various companies, particularly the imperative separation of the electric-light company and the electric-railway properties, was left to the security holders. After making inquiries, Judge Hook concluded that there would not be money enough to take care of both interest and improvements, but said that he was willing that the payment of cash for interest should make necessary receivers' certificates for improvements if reorganization was in prospect. Authorization was given to proceed with extensions and improvements recognized as necessary under the franchises whether reorganization is effected or not. It was generally understood at the time of the trial that bankers and others holding securities would seek to effect a method of separating the light and railway companies, adjusting the debts and effecting reorganization. Mr. Frank Hagerman, attorney for the receivers, called attention to the fact that about $200,000 of interest was due on May 1 and May 15, and that if money was taken from funds to pay this interest not enough would be left to make the improvements necessary under the contract with the city. About $600,000 should be spent in improvements at once to comply with contract obligations

to the city as to extensions and maintenance of quality of tracks and service. Mayor Jost declared that, even if reorganization were effected, the contract obligations as to betterments would have to be met. He put them at $6,000,000, before the bondholders should receive anything. He declared that there would be no extension of time for reorganization and acceptance of the franchise after July 7 unless there was a very strong presumption that reorganization was assured. A schedule of betterments shows that $2,427,865 must be spent in 1915 for maintenance and reconstruction and extensions under franchises; that the estimated earnings for 1915 should be $6,447,000; that the estimated expenditures, including interest and the $2,427,865 item above mentioned, would be $7,306,965. The expenditures therefore would be $859,965 in excess of income. The interest paid in 1914 was $1,459,000. The showing of the figures was to the effect that if the required betterments were paid for from income there would be only $707,935 left toward the interest. The court instructed the receivers to proceed with the improvements.

Portland (Ore.) Railway, Light & Power Company.—A meeting of stockholders has been called for May 14 to vote on the following propositions: (1) Stockholders shall surrender 20 per cent of their stock, which is 75 per cent paid, $25,000,000 now being outstanding, paying $25 in cash for each share surrendered. In exchange for the surrendered stock they shall receive full-paid preferred stock, share for share, one-half to be 6 per cent cumulative first preferred, the other one-half to be 6 per cent non-cumulative second preferred. (2) The authorized stock shall be increased $10,000,000, to consist of $5,000,000 of 6 per cent first preferred stock cumulative from Jan. 1, 1916, and $5,000,000 of 6 per cent non-cumulative second preferred. (3) Should stockholders approve the foregoing, $5,000,000 of the outstanding stock shall be retired. The annual report for the year ended Dec. 31, 1914, states that the unsatisfactory showing was due to a continuation of the depressed business conditions prevailing in 1913, and to the competition of the Northwestern Electric Company. The number of customers was reduced from 42,062 to 37,938, and the earnings from $2,430,927 to $2,241,834, or 7.8 per cent. Mr. Franklin T. Griffith, the president, states that the prospects for the future are not so unfavorable as might be indicated by these statements. Considering all the factors involved in a competitive fight, further material losses of existing business due to the company's electric competitor are not anticipated, and the company believes that it is fully able to secure the major portion of any new business developed. Taxes and operating expenses will be greatly reduced in 1915. The capital expenditures required during this year will be the smallest in ten years. The company is spending money only where absolutely necessary and to complete work already begun. Comparative earnings for 1913 and 1914 follow:

	1914	1913
Gross earnings	$6,273,171	$6,723,742
Operating expenses	2,695,356	2,856,981
Net earnings	$3,577,815	$3,866,761
Taxes	$568,527	$441,329
*Bridge rentals	45,198	46,936
Interest	2,127,480	1,961,666
Total fixed charges	$2,741,205	$2,449,931
Surplus	$836,610	$1,416,830

*Additional bridge rentals amounting to $16,267 in 1914 and $16,903 in 1913 are included in operating expenses.

Southern Canada Power Company, Montreal, P. Q., Canada.—A meeting of holders of the 6 per cent first mortgage bonds will be held on May 17 for the purpose of modifying the deed of trust and mortgage so that the company shall be at liberty, after issuing $3,000,000 of bonds, to issue $2,000,000 additional bonds, but only for an amount equal to 80 per cent of the actual cost of improvements, betterments, etc., and then only provided that net earnings for twelve months ending not more than sixty days prior to application for such additional issues shall not be less than one and one-half times the interest charged on all bonds outstanding including those to be issued.

Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa.—The directors voted at a special meeting May 5 to alter the prevailing provisions for the conversion of convertible bonds into stock. The conversion price of 200 will, under the plan, be reduced to par for the rest of the year, and thereafter will be 110. Bondholders will be asked to consent to a change in the trust indenture under which the bonds were issued in return for the more favorable terms of conversion proposed. The clause in the indenture reads: "The Electric company will not issue additional stock entitled to preference or priority over its 'assenting stock,' nor distribute any capital stock by way of stock dividends, nor issue any capital stock at a price more than 10 per cent below the market price of the stock of the same class at the time the new stock is offered for subscription or sale." In case the plan becomes operative, either common stock of the company to the amount required for conversion under the plan or new bonds convertible into common stock at the reduced price will be offered to shareholders for pro rata subscription at 105. To the extent that stock or bonds are sold upon this basis the proceeds will be used to retire the present bonds at the redemption price. There are $19,476,000 5 per cent convertibles outstanding. The plan provides that new bonds may be exchanged for the old at par. Also, bonds presented for payment in cash will be paid off at 105, while the exchange may be made part for cash and part for new bonds. The company will not require additional capital, according to a statement by the directors, for its present volume of business or for any increase expected in the near future. It has made adequate provision without borrowing for the execution of the large orders recently received from foreign governments. On the other hand, in case of the radical increase of business which may come with good times, the company would be handicapped in securing additional capital by the restriction in the trust indenture.

Manufacturing and Industrial

The Standard Paint Company has moved its New York offices from 100 William Street to the Woolworth Building.

The Peerless Rubber Manufacturing Company has moved from 16 Warren Street, New York, to larger quarters at 31 Warren Street.

The General Lead Batteries Company, Newark, N. J., has moved its Chicago office from 2332 Michigan Avenue to 219 East Twenty-fourth Street.

The Phoenix Glass Company has moved its showrooms from 15 Murray Street, New York, to the Victoria Building, 230 Fifth Avenue, New York.

The National Conduit & Cable Company, 41 Park Row, New York, has moved its Chicago office from 736 Rookery Building to 72 West Adams Street.

The Habirshaw Wire Company, Yonkers, N. Y., has moved its New York office from the Metropolitan Tower to 10 East Forty-third Street, New York City.

The Bell Electric Motor Company, Garwood, N. J., has opened an office in the Monadnock Block, Chicago, Ill., which will be in charge of Mr. Herman Dreyer.

The Wagner Electric Manufacturing Company, St. Louis, Mo., has moved its office in Minneapolis, Minn., from 1040 Security Bank Building, to 307 Security Building.

The Bodine Electric Company has moved its factory, offices and salesrooms from 564 West Randolph Street, Chicago, to Oakley Boulevard and Ohio Street, Chicago.

The Wyckoff Pipe & Creosoting Company has moved its offices from 50 Church Street, New York, to the Forty-second Street Building at 30 East Forty-second Street, New York City.

The American Ever Ready Works of the National Carbon Company have moved from 308 Hudson Street, New York, to Thompson Avenue and Barton Street, Long Island City, N. Y.

The G. & W. Electric Specialty Company has moved its factory and offices from 6308 Blackstone Avenue to 7440-52 South Chicago Avenue, Chicago, Ill. More floor space and better manufacturing facilities are available at the company's new location. Among central stations the company's well-known products include its combination pothead and switch.

The Adams-Bagnall Electric Company, Cleveland, Ohio, has moved its New York office from 40 Wall Street to 30 Church Street, and its Chicago office from 417 South Dearborn Street to the Fisher Building.

The Nordberg Manufacturing Company, Milwaukee, Wis., maker of Corliss engines, uniflow engines, oil engines, etc., has moved its New York City office from 42 Broadway to the New Equitable Building, 120 Broadway, New York City.

The Electric Horsepower Company, 906 Elm Street, Cincinnati, Ohio, has filed a deed of assignment for the benefit of its creditors in favor of Mr. M. G. Overend, its secretary and treasurer. Liabilities of about $5,000 are listed, with assets of half that amount.

Oxygen and Hydrogen Electrolytic Apparatus for Japan.—H. L. Barnitz, sales agent for the International Oxygen Company, 115 Broadway, New York, has closed a contract with the Tokio Electric Company, Tokio, Japan, for a large installation of cells for the electrolytic production of oxygen and hydrogen gas.

The Chicago Chandelier & Bronze Company of Chicago, Ill., will succeed to the business of the retail department of the D. L. Braun Manufacturing Company, the wholesale department of which was recently taken over by the Beardslee Manufacturing Company of Chicago. The new fixture firm will be established at the corner of Wabash Avenue and Washington Boulevard and will be under the direction of Mr. John Ricklefs and Mr. George Kaiser.

Westinghouse Sales School.—The close of the term of the sales school of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., April 30, was made the occasion of a dinner in the Seventh Avenue Hotel, Pittsburgh. Mr. T. H. Whipple, manager of sales, acted as the toastmaster, and a number of informal speeches were delivered. Members of the class voted to organize a club to meet monthly for the discussion of salesmanship and the promotion of good fellowship.

Wm. McLean & Company.—Mr. O. L. Remington, general manager for Wm. McLean & Company, 127 Elizabeth Street, Melbourne, Australia, recently arrived in the United States to investigate electrical products of American manufacture. Mr. Remington's temporary address is 3219 North Capital Avenue, Indianapolis, Ind. Mr. Remington will shortly join Mr. H. P. McColl, engineer for Wm. McLean & Company, who is now at the Hotel LaSalle, Chicago, after which both will visit industrial centers in the East and finally proceed to England.

The Bison Electrical Company, 259 Pearl Street, Buffalo, N. Y., has recently been incorporated and is the successor of the J. C. Sterns Electrical Company, of the same address. Mr. J. T. Arundell, for seven years vice-president of the J. C. Sterns Electrical Company, is president and treasurer; Mr. B. H. Fisher, superintendent of the J. C. Sterns Electrical Company for three years, is vice-president, and Mr. F. M. Smith, bookkeeper for the J. C. Sterns Electrical Company for eight years, is secretary. The company is engaged in a general electrical contracting and supply business.

The More Electric Company, Denver, Col., has been established by Mr. O. S. More, who for the last five years has been chief engineer of the Fairbanks Morse Electric Manufacturing Company, Indianapolis, Ind. The More Electric Company will have its offices in the Gas and Electric Building, Denver, and besides handling engineering work will act as district representative for a number of well-known manufacturers of electrical apparatus. A specialty will also be made of engineering designs and investigations. Prior to Mr. More's connection with the Fairbanks Morse company, he was a designing engineer with the Western Electric Company at Hawthorne, Ill.

Mr. Robert C. Fenner, who for the last nine years has been connected with the Cutler-Hammer Manufacturing Company, of Milwaukee, Wis., has resigned as manager of the Chicago office of that company and has opened an office of his own in the People's Gas Building, Chicago, where he is acting as manager of sales for a number of mechanical and electrical specialties. Mr. Fenner was for three years manager of the Boston office of the Cutler-Hammer Company and prior thereto was instructor in physics at Cornell, where he graduated in 1903. Mr. Fenner is a member of the American Institute of Electrical Engineers and has taken an active part in the work of the Chicago Association of Commerce, being chairman of the electrical subdivision of that association and a member of its ways and means council.

Orders for Turbine Equipment.—The Kerr Turbine Company, Wellsville, N. Y., reports that it has recently received the following orders: City of Atlantic City, N. J., an 18,000,000-gal. turbo-pump; city of Baltimore, a 500-kw turbo-generator; city of Williamsport, Pa., a 425-hp turbine for driving a pump; city of Youngstown, Ohio, two 250-kw turbo-alternators; the dredge *Columbia*, port of Portland, Ore., two 100-hp geared turbines; Swift & Company, Chicago, three turbines; the Christian Moerlein Brewing Company, Cincinnati, a 300-kw turbo-generator; the Carnegie Steel Company, Farrell, Pa., a 125-hp turbine; the Jones & Laughlin Steel Company, Woodlawn, Pa., a 325-hp turbine; the National Tube Company, for the Christy Park Works, McKeesport, Pa., a 350-hp turbine. The company has also recently received orders for equipment from the East Hull Gas Company, Groves, England; the Corporation Gas Works, Birkenhead, England, and Armour de la Plata, Argentina.

More Factory Space for Duncan Company.—The Duncan Electric Manufacturing Company of Lafayette, Ind., has purchased an adjoining factory which for many years was occupied by the Sterling Telephone Company. This addition, 51,000 sq. ft. in area, now gives the Duncan Electric Manufacturing Company approximately 100,000 sq. ft. of factory floor space. The newly acquired buildings are being brought up to date by the installation of large windows and a sprinkler system. To supply the additional power and steam heating required, a new generating station is being built, in which a 500-hp steam turbine is to be installed. The testing, assembling and shipping departments and portions of the company's transformer factory are being moved into the new quarters. This expansion has been made necessary, said Mr. Thomas Duncan, president of the company, by the healthy growth of business in the company's present products and to accommodate several new lines that the company hopes to take up during the summer.

Builders Equipping Houses with Stationary Cleaners to Increase Their Value.—Mr. A. C. Smucker, 30 Church Street, New York, ventilating engineer and agent for the Thurman Vacuum Cleaner Company, St. Louis, Mo., reports that many contractors and builders who erect dwelling houses purely for investment purposes are equipping such buildings with stationary vacuum-cleaning apparatus to enhance their value. Prospective buyers, he asserts, are always favorably impressed by such equipment, which he considers to be among the highly desirable "improvements." Mr. Smucker states that business in stationary cleaners is not so good now as it might be, as there has been no activity in the building industry for some time. There are indications, however, of an improvement in the near future. Mr. Smucker has also developed a ball-shooting target which is operated by means of an electrically operated blower. Two of these devices have recently been installed at the Panama-Pacific Exposition and another at Atlantic City. The device was described in the ELECTRICAL WORLD of June 13, 1914.

A 20,000-kw Turbine Set for Toledo.—The Toledo Railways & Light Company, Toledo, Ohio, has contracted with the Westinghouse Electric & Manufacturing Company for the installation of a 20,000-kw turbo-generator set and a 25,000-sq. ft. surface condenser for its Water Street generating plant. In connection with this installation the company will establish a complete new generator-bus system and install new switching equipment. This contract was also awarded to the Westinghouse company. An extension is now being added to the Detroit Avenue generating station, where will be installed within the next three months a 1500-kw frequency-changer set, a 1500-kw rotary converter, and sixteen mercury-arc street-lighting sets, besides three 1000-kw, 23,000-volt transformers, which will be supplied from the 23,000-volt underground transmission. The demand for

electric power in Toledo has made remarkable strides in the last two years, and the local company, according to Mr. F. J. Derge, manager of light, heat and power, has found it necessary practically to triple its main-station rating since Henry L. Doherty & Company took over the operation of the property.

Orders for Electrical Equipment.—As an indication of the revival of business activity the following orders received by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., from central stations, industrial companies, Cuban sugar mills, etc., are of interest: The Merchants' Heat & Light Company, Indianapolis, Ind., one 1500-kw, 250-volt synchronous booster rotary converter arranged for 15 per cent buck or boost, three 550-kva, single-phase, oil-insulated, self-cooled transformers and one three-panel switchboard; the Scranton & Binghamton Railroad Company, Scranton, Pa., one 400-kw, 600-volt rotary converter, three 150-kva, oil-insulated, self-cooled transformers and one two-panel switchboard; the Home Lawn Mineral Springs Company, Martinsville, Ind., two 25-kw, 125-volt direct-current generators; the Woman's Hospital, New York, one 100-kw, 250-volt direct-current generator; city of Yonkers, New York, one 25-kw, 125-volt direct current generator; the Harrisburg Foundry & Machine Works, Harrisburg, Pa., one 35-kw, 125-volt direct-current generator; the Queens Borough Gas & Electric Company, Far Rockaway, one 75-kw, 125-volt direct-current generator and one turbine and gearing for driving generator; city of Seattle, Wash., one 75-kw, 125-250-volt, three-wire direct-current generator; the Laclede Gas Light Company, St. Louis, Mo., one 30-kw, 125-volt turbo-generator, one 30-kw, 125-volt motor-generator exciter set, one 75-kw, 250-volt direct-current motor-generator exciter set, one eleven-panel switchboard and a 5000-kva turbo-generator; the Hatefield Electric Company for the Indianapolis (Ind.) City Hospital, one 150-kw, 125-volt direct-current generator; the Duquesne Light Company, Pittsburgh, Pa., one 500-kw, 125-250 volt, three-wire direct-current and 11,300-volt alternating-current three-phase synchronous motor-generator set, and one switchboard starting panel for controlling the alternating-current end of the set; the Pacific Electric Railway Company, Los Angeles, Cal., one 1000-kw, 600-volt direct-current and 15,000-volt alternating-current synchronous motor-generator set; the Edison Electric Illuminating Company, Brooklyn, N. Y., one 1000-kw, 270-volt direct-current and 6300-volt alternating-current synchronous motor-generator set; the Dibert Van Croft & Ross Company, for use in its sugar mills in the provinces of Oriente and Camaguey, Cuba, one 300-hp alternating-current motor for driving a crusher and two sets of rolls, one 250-hp alternating-current motor for driving two sets of rolls, one 250-hp alternating-current motor for driving a crusher and two sets of rolls, one 200-hp motor for driving two sets of rolls, switchboard equipment for controlling the motors, and two 2800-ton storage-battery locomotives.

NEW YORK METAL MARKET PRICES

	April 27 Selling Prices Bid	Asked	May 4 Selling Prices Bid	Asked
Copper	£ s d		£ s d	
London, standard spot*	81 5 0		76 0 0	
Prime Lake	18.62½ to	18.87½	18.62½ to	18.87½
Electrolytic	18.50 to	18.62½	18.37½ to	18.50
Casting	17.75 to	18.00	17.37½ to	17.50
Copper wire base	19.87½		20.00	
Lead	4.20		4.20	
Nickel	42.00 to	45.00	42.00 to	45.00
Sheet zinc, f.o.b. smelter	14.50		17.50	
Spelter	14.00		13.50 to	13.75†
Straits tin	42.00†		39.50†	
Aluminum, 98 to 99 per cent	18.75 to	19.00	19.25 to	19.50

*OLD METALS

Heavy copper and wire	17.00	17.00
Brass, heavy	11.00	11.25
Brass, light	9.00	9.25
Lead, heavy	3.95	3.95
Zinc, scrap	9.50	10.50

*COPPER EXPORTS

Total tons to May 4	3,471

*From daily transactions on the New York Metal Exchange.
†Nominal.

New Incorporations

The Hilliards Light & Power Company, of Hilliards, Ohio, has been incorporated by Le Roy Bobyns, T. C. Latham and others. The company is capitalized at $10,000 and proposes to construct and operate an electric-light plant in Hilliards.

The Allen County Electric Light & Power Company, of Grabill, Ind., has been incorporated with a capital stock of $15,000 by Alfred A. Pointer, Peter S. Amstutz, George H. Krudop, Julius Hehrig and Albert Egly. The company proposes to supply electricity in Shirley, Grabill, Harlan and other towns.

New Industrial Companies

The Hammerle Lighting Fixture Company, of Syracuse, N. Y., has been incorporated with a capital stock of $10,000 by Henrietta S. Hammerle, C. H. Hammerle and Clarence Hammerle, of Syracuse, N. Y.

The Simon Venti-Lighter Company, of New York, N. Y., has been chartered with a capital stock of $50,000 by Leopold Simon, 38 Union Square, New York, N. Y.; Sidney H. Weinberg and Simon C. Weinberg, of Brooklyn, N. Y. The company proposes to manufacture and deal in lighting appliances.

Trade Publications

Steel Poles.—R. D. Coombs & Company, Hudson Terminal, New York, are sending out postal cards which illustrate installations of poles and transmission towers.

Lighting Fixtures.—The Alter Light Company, 827 South Loomis Street, Chicago, Ill., has issued a folder describing and illustrating a number of lighting fixtures.

Molding Fittings.—Jordan Brothers, Inc., 80 Beekman Street, New York, have issued a folder which describes their cross-overs and connectors for use with wooden moldings.

Watt-Hour Meters.—The Sangamo Electric Company, Springfield, Ill., has issued folders describing its type D-5 and type H watt-hour meters and its type M-S ampere-hour meter.

Demand Indicators.—Bulletins No. 46,100 and No. 46,101, recently issued by the Fort Wayne (Ind.) Electric Works of the General Electric Company, describe type M and type P demand indicators.

Small Dental Motor.—The Shelton Electric Company, 30 West Forty-second Street, New York, has issued a folder which describes and illustrates a small motor for direct connection to dental tools.

Railway Dispatching Equipment.—The Kellogg Switchboard & Supply Company of Chicago has issued Bulletin No. 82, describing and illustrating telephone apparatus for railway signaling and dispatching.

Resuscitating Apparatus.—The Life Saving Devices Company, 565 Washington Boulevard, Chicago, Ill., is distributing a folder which contains information on a resuscitating device called a "lungmotor."

Sign Lighting.—Bulletin No. 43,550, recently issued by the Edison Lamp Works of the General Electric Company, Harrison, N. J., contains information on and illustrations of a large number of sign-lamp installations.

Storage Batteries.—The Electric Storage Battery Company, Philadelphia, Pa., has issued a catalog, designated as Section X, which contains information on several types of batteries for electric vehicles, and Bulletin 148, describing its standby batteries.

Salesmen's Handbook on Lamps.—"The Story of Artificial Illumination" is the subject of a booklet designated as "Salesmen's Lamp Handbook, Series No. 1," which has recently been published by the Westinghouse Lamp Company, 1261 Broadway, New York.

Incandescent-Lamp Fixtures.—Pass & Seymour, Inc., Solvay, N. Y., have recently issued four folders on conduit-box straps for outlet boxes without lugs or ears, electric-candle-lamp sockets, sockets and receptacles for nitrogen-filled lamps, and decorative devices for temporary and permanent illumination.

Construction News

New England

HERMON, MAINE.—The Black Stream El. Co., of Hermon, has applied to the Public Utilities Commission for permission to issue $10,000 in capital stock and $5,000 in bonds, the proceeds to be used to purchase real estate, acquire water rights, build power plant, erect transmission lines and distributing system, etc., in connection with its proposed electric system. Harry H. Leathers is president.

STANDISH, MAINE.—The Cumberland County Lt. & Pwr. Co., of Portland, has applied for a franchise to supply electricity in the town of Standish.

BOSTON, MASS.—Bids will be received at the office of John Grady, fire commissioner, Bristol Street, Boston, until May 11 for doing work in connection with the underground fire-alarm system of the Fire Department of the city of Boston, consisting of laying about 2900 ft. of single duct, 95 ft. of two ducts, 130 ft. of four ducts, setting about 32 lamp-posts and five test posts, and building two manholes. Plans and specifications may be obtained at the above office.

BROCKTON, MASS.—The Edison El. Illg. Co. of Brockton has applied for a permit to erect a substation on Ames Street, to cost about $3,500.

SWANSEA, MASS.—The town of Swansea has voted to award the Fall River El. Lt. Co. a contract for lighting the Hortonville Road, from Swazey's Corner to the Rehoboth town line. The contract is for a period of five years and calls for the installation of 190 electric lamps.

NEWPORT, R. I.—The contract for installing electric lamps in the Coggeshall, Calvert, Cranston and Townsend Industrial School buildings has been awarded to Chase & Hazard. Tungsten lamps will be used and wires are to be placed in armored tubing.

NEW BRITAIN, CONN.—Mayor George A. Quigley has vetoed the resolution passed by the City Council to submit to the voters at the next city election the proposal to establish a municipal electric-lighting plant.

Middle Atlantic

DANSVILLE, N. Y.—The Dansville Gas & El. Lt. Co. has closed a contract with the village of Dansville for lighting the streets of the village for a period of five years, which provides for the installation of 22 ornamental single lamp-posts, carrying lamps of 600 cp, 38 lamps of 250 cp. with Holophane reflectors, and 155 lamps of 60 cp with radial-wave reflectors, all type "C" lamps, replacing 42 arc lamps and 94 40-cp incandescent lamps. Charles G. McAvoy is superintendent.

EAST ROCHESTER, N. Y.—The installation of an ornamental street-lighting system on Commercial Street between Washington and Madison Streets is reported to be under consideration.

ELMIRA, N. Y.—The Elmira Wtr., Lt. & R. R. Co. expects to purchase one 600-kva, 22,000/2200-volt transformer, 1000 irons and 500 fans. F. H. Hill is general manager.

NEW YORK, N. Y.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 3 for installing new lighting fixtures in the United States Sub-treasury at New York. For details see proposal columns.

SOLVAY, N. Y.—The Water and Light Department expects to purchase within the next three months several transformers and lightning arresters for the municipal lighting system. Charles H. Cross is superintendent of the water and light department.

COUDERSPORT, PA.—Within the next few months the Home El. Co., of Coudersport, expects to change its system from 133 cycles to 60 cycles, 2300 volts, and establish a day service; also to purchase within the next three months one 125-hp gas engine, two 90-kw to 115-kw alternators, and a 40-kw alternator. As soon as the system is changed the company expects to put in a supply of electrical labor-saving devices. On April 1 the old open Brush arc-lamp street-lighting system was replaced with a Westinghouse regulator and type "C" 6.6-amp lamps. D. B. Belknap is manager.

EASTON, PA.—The contract for the construction of the new chapel at Lafayette College has been awarded to F. L. Hoover & Son, of Philadelphia, Pa. The electrical equipment will be very elaborate. Carrère & Hastings, 225 Fifth Avenue, New York, N. Y., are architects.

HAMBURG, PA.—Within the next 30 days the Hamburg Gas & El. Co. expects to purchase from 30 to 40 lightning arresters. A. J. Althouse is superintendent and purchasing agent.

McDONALDTON, PA. (not a post office).—The Brothers Valley Coal Co., of McDonaldton, is installing a substation and several motors to operate the machinery in its mines with electricity. Energy will be secured from Johnstown.

MILLVALE, PA.—Within the next four months the Electric Light Commissioners expect to purchase one 500-hp turbine and generator and two 200-hp water-tube boilers. James Grundy is superintendent.

SADSBURYVILLE, PA.—The Chester Valley El. Co. is contemplating supplying electrical service in Sadsburyville. Rights of way for the transmission line, it is reported, have been secured.

SCRANTON, PA.—The Scranton El. Co. is contemplating improvements to its steam-heating system, at a cost of about $125,000, which will include the erection of a substation at the junction of Archibald and Peckville and at Moosic to replace present buildings. Extensions will also be made to the electric lines north and south of the city.

STROUDSBURG, PA.—The Citizens' Gas & El. Co., of Stroudsburg, is building a substation, to have an ultimate output of 1800 kva, and 3 miles of transmission line. John E. Harbaugh is superintendent electrical department.

MILLBURN, N. J.—The Morris County Trac. Co., of Morristown, has signed a contract with the Millburn El. Co., whereby the latter will furnish electricity to operate the cars on the western end of its lines. The Millburn company will rebuild and enlarge its plant to meet the requirements of the additional service.

SUSSEX, N. J.—The Woodbourne El. Lt., Ht. & Pwr. Co., of Sussex, expects to rebuild a portion of its lines. Irvin D. Shorter is secretary and treasurer.

UNION BRIDGE, MD.—The Union Bridge El. Mfg. Co., recently incorporated, it is reported, will take over the local electric-light plant, owned by Ezra A. C. Bucky, and will also install an ice factory. The company has been granted a 25-year franchise for street lighting. Clarence E. Easterday is president, and Orville E. Shiffler treasurer, both of Hagerstown.

WALKERSVILLE, MD.—The Council has awarded the Hagerstown & Frederick Ry. Co., of Hagerstown, contract to furnish electricity in Walkersville. A transmission line will be erected from Frederick to Walkersville, a distance of 5 miles, to cost about $4,000.

HUNTINGTON, W. VA.—The Lincoln Coal Mining Corp. is planning to install a generating plant at Big Creek. Contracts for machinery, it is understood, have been awarded.

PARKERSBURG, W. VA.—Bids will be received at the office of the supervising architect, Washington, D. C., until May 25 for changes in plumbing, conduit and wiring system and lighting fixtures in the United States post office and court house at Parkersburg, W. Va. For details see proposal columns.

FRONT ROYAL, VA.—Bids will be received by the constructing quartermaster, Remount Depot, Front Royal, Va., until May 24, for construction, including steam heat, electric lighting and plumbing, of double N. C. O. quarters, civilian employees' quarters, isolated quarters for enlisted men, veterinary ward, colt stable, quartermaster's stable, granary and hay sheds, granary office, farm implement shed, coal shed and oil house. Further information may be obtained upon application to the constructing quartermaster.

LYNCHBURG, VA.—The Lynchburg Trac. & Lt. Co., it is reported, has authorized an expenditure of $85,000 for rebuilding its electric distributing systems. The company has also made other appropriations to provide for enlarging the Blackwater power station and gas plant.

MONTEREY, VA.—Within the next six months the Monterey Garage & Lt. Co. expects to purchase and install one 50-hp boiler, one 40-hp engine and a 25-kw generator. C. M. Lunsford is manager.

WASHINGTON, D. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until May 11 for furnishing at the various navy yards and naval stations supplies as follows: Newport, R. I., Schedule 8219—15,600 ft. double-conductor cable; Schedule 8220—miscellaneous brass tubing and bronze tubing. Bids will also be received at the same place until May 18 as follows: Brooklyn, N. Y., Schedule 8224—miscellaneous annunciators, vibrating bells, W. T. buzzers, etc., W. T. push-button, miscellaneous thermostat frames, contact makers, mercurial thermostats, etc.; Schedule 8249—miscellaneous N. W. T. junction and branch boxes, miscellaneous electrical ceiling fixtures, anchor lights, etc., cargo reflectors, etc., electrical supplies, switches, receptacles, etc.; Schedule 8248—5000 ft. electrical cable, 75 storage battery jars; Schedule 8241—2000 ft. interior-communication cable, 24,600 ft. single-conductor wire, 2000 ft. twin-conductor wire; Schedule 8235—50,000 ft. lighting and power wire, 6200 ft. single rubber-covered wire; Schedule 8242—29,150 lb. condenser tubes. Newport, R. I., Schedule 8246—miscellaneous sheet and copper tubing; Schedule 8245—miscellaneous sheet copper. Norfolk, Va., Schedule 8238—miscellaneous sheet brass. Philadelphia, Pa., Schedule 8244—2940 lb. sheet copper. Portsmouth, N. H., Schedule 8242—miscellaneous composition unions. Applications for proposals should designate the schedule desired by number.

North Central

BATTLE CREEK, MICH.—Plans are being prepared for the proposed power building to be erected on South McCamley Street. Ralph Holmes, of the Hygienic Food Co., is interested in the project.

CAMDEN, MICH.—Arrangements have been made by Walter Griggs, of Camden, recently granted a franchise to supply electricity here, to install an electric plant. The equipment will include a Loomis fuel-oil engine, General Electric generator, switchboard, etc.

CHARLEVOIX, MICH.—Within the next six months the Board of Public Works expects to purchase for the municipal electric-lighting system three transformers (two of 5 kva and one of 7½ kva), about 200 incandescent lamps and 1000 ft. of wire for pole line.

SAGINAW, MICH.—Application has been made to the City Council by the West Side Business Association for the installation of 100 ornamental lamps to be placed on the principal streets in the West Side business district. The association offers to pay for the lamps and the installation, provided that the city will furnish the energy and maintain them.

TEKONSHA, MICH.—The Tekonsha El. Co., recently incorporated, it is reported, will take over the local plant and will enlarge and improve it.

CANAL DOVER, OHIO.—The City Council, it is reported, is contemplating changing the motive power of the municipal electric-light plant from gas to steam.

CINCINNATI, OHIO.—Bids will be received at the office of the clerk of the board of education, third floor, City Hall, Cincinnati, until May 24 for furnishing materials and installing an electric-lighting system in the College Hill School, located on Maple Avenue, College Hill, and the Mount Airy School, located at Colerain Pike and Mount Airy Road, in accordance with plans and specifications on file in the office of C. W. Handman, business manager, 511 West Court Street, Cincinnati.

CLEVELAND, OHIO.—Bids will be received at the office of the commissioner of purchases and supplies, Room 511, City Hall, Cleveland, until May 14 for electric meters for the electric-light plant. Plans and specifications may be obtained at the office of the light and heat division, 1143 East Third Street, Cleveland.

DAYTON, OHIO.—Arrangements are being made by the Atlas Portland Cement Co., which recently acquired over 1000 acres of land between this city and Tippecanoe City, to secure electrical service from the Dayton Pwr. & Lt. Co.

EAST YOUNGSTOWN, OHIO.—Investigations are being made by the city authorities with a view of installing a new street-lighting system.

HAMILTON, OHIO.—Plans have been completed by the West Side Commercial Association for the installation of an ornamental lighting system, which provides for 30 ornamental standards carrying five-lamp clusters, maintained by underground wires, to cost about $3,250, to be paid by merchants and property holders. The Electric Department of the city is to install the system and maintain same for a period of five years for the amount named.

KENT, OHIO.—Bids will be received by the board of trustees of the Kent Normal School, Kent, Ohio, until May 15, for the construction of power house, coal bin and tunnel connection of the heating plant and equipment for the Normal School. John A. McDowell is secretary board of trustees.

KINGSTON, OHIO. — Preparations are being made by Mr. Newmyer, of Circleville, for the installation of an electric-lighting system in Kingston. Electricity for operating the plant will be obtained from the transmission lines of the Scioto Valley Trac. Co.

LORAIN, OHIO—The City Council has decided to submit the proposal to issue $350,000 in bonds for the construction of a municipal electric-lighting plant to the voters.

NEW PHILADELPHIA, OHIO — The Ohio Ser. Co. is planning to replace the 300-cp lamps now in use with lamps of 600 cp. C. H. Howell is manager.

POMEROY, OHIO.—The capital stock of the Ohio River El. Ry. & Pwr. Co., of Pomeroy, has been increased to $500,000, the proceeds to be used to complete the construction of its power plant and other improvements.

SHANDON, OHIO—The Shandon Illg. Co., recently organized, will soon install an electric-light plant to furnish electricity for lighting the streets and residences of the village. Equipment, it is understood, has already been purchased.

TRENTON, OHIO.—The Council has rejected all bids submitted for street lighting and will ask for new bids. The town is now lighted by gasoline lamps, and it is proposed to discard the gasoline lamps and install an electric-lighting system.

YOUNGSTOWN, OHIO.—The Youngstown & Sharon St. Ry. Co., successor to the Youngstown Consol. Gas & El. Co., expects to purchase within the next two months conduit, cable, junction boxes, subway transformers, etc., for an underground distribution system in the business district. E. H. Beil is manager of the light and power department.

EVANSVILLE, IND. — The Evansville Pub. Ser. Co. is contemplating the erection of a transmission line from Patoka to Winslow to supply electrical service in the latter place.

RICHMOND, IND.—The City Council has voted to take over the plant of the Richmond Lt., Ht. & Pwr. Co., to be operated in connection with the municipal electric-light plant.

CANTON, ILL.—The City Council is considering improving the lighting system on East Elm and East Chestnut Streets from the Public Square to Fourth Avenue and the Burlington passenger station.

CHICAGO, ILL.—Bids will be received by John McGillen, clerk of the Sanitary District of Chicago, Room 700, 910 South Michigan Avenue, Chicago, until May 20 for furnishing compensators with glassware and fixtures complete. Specifications and proposal forms may be obtained at the above office.

ELIZABETH, ILL.—The installation of an electric-light plant in Elizabeth is under consideration. The sum of $8,000, it is reported, has been subscribed for this purpose.

LA SALLE, ILL.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until May 26 for construction complete, including mechanical equipment, lighting fixtures and approaches, of the United States post office at La Salle. Drawings and specifications may be obtained at the above office or from the custodian of site at La Salle.

URBANA, ILL.—Bids will be received at the office of James B. Dibelka, state architect, 130 North Fifth Avenue, Chicago, until June 1 for furnishing and installing general electrical, heating and ventilating and plumbing apparatus for the School of Education, Vivarium and Ceramics Buildings of the University of Illinois. Plans and specifications may be obtained at the above address.

ASHLAND, WIS.—The Ironwood & Bessemer Ry. & Lt. Co., of Ashland, which controls the local electric light and power plant and street railway, is reported to be contemplating the construction of a new hydroelectric power plant (10,000 kw), the location for which has not yet been decided upon; also the construction of a 5000-kw steam turbine-driven plant to be located on the lake front at Ashland. Arthur E. Appleyard, of Ashland, is vice-president and manager.

MANITOWOC, WIS.—The Board of Education has engaged Earl F. Miller, architect, to prepare plans and to advertise for bids for the construction of a central heating, lighting and power plant for the Manitowoc High School. The cost of proposed plant is estimated at $15,000.

MOUNT HOREB, WIS. — Preparations are being made by the Mount Horeb Ht., Lt. & Pwr. Co. for the installation of an ornamental lighting system, covering four blocks. Contracts have already been placed for the cable. From 20 to 24 ornamental standards, to carry five-lamp clusters, are still to be purchased.

OSLO (R. F. D. CATO), WIS.—The capital stock of the Oslo Lt. & Pwr. Co. has been increased from $5,000 to $30,000, the proceeds to be used to reconstruct the hydroelectric power plant, which was damaged by floods.

EDEN VALLEY, MINN.—The village of Eden Valley has contracted with the Pub. Ser. Co. of St. Cloud to furnish electricity for lighting the village. A. G. Whitney, of St. Cloud, is president of the company.

FOUNTAIN, MINN.—The Village Council has entered into a contract with the Root River Co. to furnish electrical service in Fountain.

WACONIA, MINN.—The village of Waconia has granted a franchise to E. F. Strong and R. F. Strong to furnish electricity for lamps and motors in Waconia. A company will be organized under the name of the Waconia Lt. & Pwr. Co. to operate the system. Ornamental lamps and a series street-lighting system will be installed. E. F. Strong is manager.

CAPLINGER MILLS (R. F. D. STOCKTON), MO.—W. A. Whinery, it is reported, is contemplating the installation of an electric-lighting plant in Caplinger Mills to supply electricity for several surrounding towns.

CORDER, MO.—Bonds to the amount of $6,000 have been voted for the installation of a municipal electric-light plant.

HIGGINSVILLE, MO.—The city of Higginsville has entered into a contract with the village of Corder to supply electricity for lamps and motors in that village. The city of Higginsville will probably purchase and install a generating unit with rating of 250 kva, switchboard and constant-current transformer. D. Riepe is superintendent.

SEDALIA, MO.—The construction of a dam across the Niangua River and power plant in Camden County for the development of electrical power is reported to be under consideration by J. B. Quigley, of Ava, Mo.

WELLSVILLE, MO.—The property of the Wellsville Lt., Pwr. & Wtr. Co. is reported to have been purchased by C. H. Lawrence, of St. Louis. The new owner will make improvements to the service.

FESSENDEN, N. D.—The Council has granted B. W. Baldwin a franchise to erect an electric transmission line in Fessenden.

RAYMOND, S. D.—The installation of an electric-lighting plant in Raymond is reported to be under consideration.

CRESCO, NEB.—Bids will be received by the village of Cresco for the construction of an electric-light plant, to cost about $5,000. G. Johnson is village clerk. Grant & Fulton, of Lincoln, are engineers.

GREAT BEND, KAN.—The question of replacing the arc lamps on the street leading to the depot with ornamental lamps is under consideration.

KINSLEY, KAN.—Plans are being considered, it is reported, by the Kinsley El. Ltg. & Pwr. Co. for the erection of a transmission line along the Santa Fé cutoff from Kinsley to Macksville. Distributing systems will be installed at both places.

Southern States

CAPE FEAR, N. C.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 7 for an electric-lighting plant at the United States quarantine station at Cape Fear, N. C. For details see proposal columns.

LAURINBURG, N. C.—The Yadkin River Pwr. Co., controlled by the Carolina Pwr. & Lt. Co., of Raleigh, is contemplating the construction of a substation in Laurinburg and furnishing electricity for lamps and motors in Laurinburg, Maxton and Lumberton.

STATESVILLE, N. C.—The Southern Pwr. Co., of Charlotte, it is reported, is contemplating the construction of a substation in Statesville, which will distribute electricity from the four generating stations of the company, including the Lookout Shoals plant, now under construction on the Catawba River, to the substations in the various towns in which the company furnishes electrical service.

ATHENS, GA.—Negotiations have been closed whereby the Athens Ry. & Lt. Co. will supply electricity in Jackson for lamps and motors. Work will begin at once on the erection of the transmission line.

HOGANSVILLE, GA.—Bonds to the amount of $5,000 have been voted for the installation of an electric-light plant.

TOCCOA, GA.—At an election to be held May 12 the proposal to issue $35,000 in bonds for the construction of a municipal electric-lighting plant will be submitted to the voters.

LAKE WORTH, FLA.—The Council is considering the question of issuing $75,000 in bonds for the installation of an electric-lighting plant and water-works system.

OCALA, FLA.—The City Council is reported to have engaged Twombly & Henney, consulting engineers, 55 Liberty Street, New York, N. Y., to take charge of the engineering work of the proposed improvements to municipal lighting plant and water-works system. The cost of the work is estimated at $75,000.

WALDO, FLA.—The Williams Realty Co., it is reported, is contemplating the installation of an electric-light plant with sufficient output to maintain 2500 to 3000 lamps. It is proposed to install a steam-driven plant, using wood for fuel. Equipment, it is understood, has not yet been purchased.

BRAEMER, TENN.—The Pittsburg Pwr. Co., of Braemer, we are informed, does not contemplate the installation of a hydroelectric power plant on the Chuckey River this summer, as reported in the issue of April 24.

MILLINGTON, TENN.—Within the next four months the Millington Lt. & Wtr. Co. expects to purchase some meters (possibly 25) and some wiring supplies. W. C. Hill is president.

JACKSON, ALA.—The City Council is reported to have granted Mr. Vincent, of Olney, Ill., a franchise to construct and operate an electric-light plant in Jackson. An ice plant will also be installed.

BOONEVILLE, ARK.—Preliminary plans, it is reported, are being prepared by the Booneville El. Co. for the erection of transmission lines to supply electricity in the towns of Charleston and Branch.

NEW ORLEANS, LA.—The New Orleans Ry. & Lt. Co., it is reported, contemplates extensive improvements to its power plant at Market and South Peters Streets.

AFTON, OKLA.—Within the next three months the town of Afton expects to purchase one heater for a 250-hp boiler (8-in. exhaust line), deep-well pump (electrically driven), a small quantity of line material, meters and station equipment. W. E. Blackwell is superintendent.

CUSHING, OKLA.—The Cushing Pub. Ser. Co., recently organized for the purpose of taking over the property of the Cushing El. Lt. & Pwr. Co., will make improvements to the property immediately, at a cost of about $20,000. H. Askin is manager.

MANNSVILLE, OKLA.—The town of Mannsville is contemplating the purchase of the local electric-light plant, to be owned and operated by the municipality. Improvements will be made to the plant if taken over by the town.

TONKAWHA, OKLA.—Within the next six months the managers of the municipal electric-light plant expect to replace the arc lamps now in use with incandescent lamps, and to purchase six 250-watt (6.6-amp) series street lamps. V. K. Stanley is manager.

HEREFORD, TEX.—Within the next three months the Hereford El. Lt. & Pwr. Co. expects to purchase one horizontal return-tubular boiler, one steam engine and generator; also within the next two months to purchase one carload of Western red-cedar poles. F. H. Oberthier is proprietor.

HICO, TEX.—Within the next three months the Central Pwr. & Trans. Co., of Hico, expects to erect two substations, of 200-kw rating and 25 miles of transmission lines; also to purchase material for 25 miles of lines carrying 150 kw in transformers (rating from 1 kva to 10 kva). H. Gleason is secretary and manager.

LAREDO, TEX.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until May 28 for remodeling an electric passenger elevator in the United States post office and custom house at Laredo. For details see proposal columns.

MINERAL WELLS, TEX.—The Mineral Wells El. Co. has recently purchased a 150-kw, two-phase, 60-cycle, 2300-volt generator and a 225-hp Ball Corliss engine, directly connected. W. T. Tucker is general manager.

NOCOMA, TEX.—The Nocoma Ice & Lt. Co. expects to purchase within the next four months a 50-hp to 100-hp oil engine and material for about ½ mile extension to transmission line; also some electrical cooking apparatus. J. W. Lehman is manager.

WINDOM, TEX.—The Texas Pwr. & Lt. Co., of Dallas, has purchased the local electric light and power plant and will make improvements to the system.

Pacific States

ANACORTES, WASH.—The Anacortes Lt. & Wtr. Co. is erecting a three-phase transmission line, 2 miles long, to the Fidalgo Island Packing Co.'s and the Alaska Packers' Association's salmon canneries, taking on a load of about 400 40-watt lamps at each place and about 60 hp of motors at the former cannery and 40 hp at the latter place, necessitating the purchase of transformers, wires, poles, etc. Douglas Allmond is president and manager.

CHEWELAH, WASH.—The proposal to erect a new hydroelectric power plant in Chewelah will be submitted to the voters. L. H. Williams is operating engineer of the municipal electric-light plant.

COLVILLE, WASH.—The City Council is considering a proposal submitted by H. R. Williams, manager of the Stevens County Pwr. & Lt. Co., of Colville, to furnish the city with electricity for lamps and motors for a period of 20 years, to be delivered at the city limits. The minimum calls for 5000 kw, with an agreement to hold in reserve 150 kw during the term of the contract.

ELLENSBURG, WASH.—Bids will be received by Reuben Crimp, city clerk, until May 14 (re-advertisement) for improvements to power plant, to cost about $60,000, as follows: Construction of power house, incuding excavation, foundations and appurtenances; modifications of existing forebay, spillway and tailrace, including enlargement of spillway, construction of new forebay, with wing wall and special inlet chambers, excavation of tailrace and basin; furnishing and delivering and installing one 1000-kw or 1200-kw steam turbine and switchboard, exciter, condenser, feed pumps, feed-water heater, boiler, new oil-pressure governor, necessary boiler brick work, breeching, stack, pipe covering and power-plant appurtenances; moving old plant to the new station of three water-power units, together with boiler, breeching and stack, penstocks and draft tubes; furnishing and installing necessary additions to penstocks and draft tubes, moving and re-erection of switchboard and wiring of building, including connection to machines and outgoing lines. Bids are to be submitted for the entire contract. Former bids for the work have been rejected.

MILAN, WASH.—Application has been made to the County Commissioners of Spokane County by the Little Spokane Lt. & Pwr. Co., of Milan, for permission to extend its transmission lines from Deer Park to the tract of the Arcadia Orchards Co., to furnish electricity for pumping and other purposes in that region.

MOSSY ROCK, WASH.—W. E. Arnold, local representative of the D. J. H. Oil Development Co., of Seattle, Wash., is reported to have secured options on land about 1 mile north of town, to be used as a power site.

OKANOGAN, WASH.—The Board of Commissioners has granted the Okanogan Valley Pwr. Co., of Spokane, a franchise to extend its transmission line from Omak to Riverside.

PORT TOWNSEND, WASH.—Application has been made to the Commissioners of Jefferson County by James P. Holman for franchises for the erection of electric transmission lines over roads and highways in Jefferson County.

SEATTLE, WASH.—Proposals and competitive designs will be received by the Board of County Commissioners of King County, Court House, Seattle, until June 7 for furnishing and installing electric fixtures in the new King County Court House, Seattle. Schedule and specifications may be obtained at the above office or from A. Warren Gould, architect, American Bank Building, Seattle, for which a deposit of $5 will be required, to be refunded upon return of plans. The cost of the fixtures is estimated at $26,000. M. J. Carrigan is chairman of commission.

TACOMA, WASH.—L. H. Bean, local manager of the Tacoma Ry., Lt. & Pwr. Co. and the Puget Sound Traction, Lt. & Pwr. Co. (Tacoma branch), has offered to the City Council the local plant of the Puget Sound Trac. Co., as an auxiliary to the municipal electric plant, provided that the city of Tacoma will drop all litigation in connection with the power franchises of the Tacoma Ry., Lt. & Pwr. Co. and allow the company to sell electricity to customers using less than 25 hp or more. The Council is also considering an offer of the Tacoma Central Htg. Co. for maintenance of an auxiliary plant. Commissioner Woods, it is stated, has expressed an opinion that the city will accept both offers.

TOPPENISH, WASH.—Preparations are being made by the Pacific Pwr. & Lt. Co., of Portland, for the installation of three transformers in its local plant, replacing the ones now in use, which are too small.

ASTORIA, ORE.—The Pacific Pwr. & Lt. Co., of Astoria, has been granted a franchise by the County Court of Clatsop County to erect transmission lines along the public highways in Clatsop County.

BARLOW, ORE.—Plans have been prepared by E. P. Preble, owner of a large ranch near Barlow, for the installation of an electric plant, to be operated by water-power, to furnish electricity to operate machines on his farm. It is proposed to supply electrical service to other ranchers in this vicinity.

BEND, ORE.—The City Council has passed a resolution granting John Steidel and Thomas Tweet a franchise to install a distributing system and supply electricity in Bend in competition with the Bend Wtr., Lt. & Pwr. Co.

BURNS, ORE.—Within the next three months the El. Lt. & Pwr. Co., of Burns, expects to install a 50-kva or a 75-kva generator in the Burns flour mill; also to purchase one 35-in. waterwheel, poles, wire, insulators and hardware for 2 miles of line. Roy C. Dwyer is secretary and manager.

LOS ANGELES, CAL.—The contract for electric wiring the sheds on the Municipal Dock No. 1 has been awarded to the Woodill-Hulse El. Co., of Los Angeles, at $2,945.

TEHACHAPI, CAL.—Work will soon begin on the installation of an electric-lighting system in Tehachapi, for which $8,000 in bonds were recently voted. Frank A. Lathrop, engineer, 1054 West Street, Los Angeles, has charge of the work.

BLACK TAIL, IDAHO (not a post office).—The Keystone Mining Co., of Black Tail, contemplates the construction of a concentrator plant and installation of an electric-light plant, water-power, mining machinery and erection of telephone line, to cost from $100,000 to $150,000. Volney B. Williamson, of Spokane, Wash., is interested in the project.

CALDWELL, IDAHO.—Through the Commercial Club the city of Caldwell has taken the initiative in a move to have the cities and towns in this region unite in arranging with the Black Canyon irrigation district for municipal lighting plants. It is estimated that one-third of the 15,000 hp to be generated by the proposed plant will be on sale the year around and two-thirds during the winter months.

MOSCOW, IDAHO.—The City Council has recently closed a contract with the Washington Wtr. Pwr. Co., of Spokane, Wash., for street-lighting, under the terms of which the company is to replace the present arc lamps with tungsten lamps, which will be installed as soon as possible.

SODA SPRINGS, IDAHO.—At a special election to be held May 15 the proposal to issue $15,000 in bonds for the purpose of installing a municipal electric-light plant will be submitted to the voters.

CASA GRANDE, ARIZ.—The city of Casa Grande has voted to grant E. R. Brackett a franchise to construct and operate an electric light and power plant here. The cost of the proposed plant, including distributing system, is estimated at from $150,000 to $200,000.

MONTROSE, COL.—Bids will be received by the city of Montrose until May 24 for the construction of an electric-light plant to cost about $6,000. E. T. Archer & Co., New England Building, Kansas City, Mo., are engineers in charge.

YUMA, COL.—Plans are being considered for the installation of a municipal electric-lighting plant in Yuma, for which bonds have been voted.

BULLION, NEV.—Plans have been completed, it is reported, by Leon M. Hall, of Virginia City, Nev., and San Francisco, Cal., for the construction of a 1500-hp power plant, with a maximum possibility of 4000 hp, to be installed on the South Fork of the Humboldt River. Energy developed at the plant, it is understood, will be utilized at the mining camp of Bullion. Permission to take water from the South Fork for power purposes has been granted, with provision that it be returned to the stream above the farm lands.

ALAMOGORDO, N. M.—The Alamogordo El. Lt. & Pwr. Co. expects to purchase within the next three months various electrical supplies.

NOGALES, N. M.—Arrangements are being made by the Nogales Gas & El. Co. to extend its transmission lines to cover a large territory in this portion of Arizona and in New Mexico. The company is erecting a large plant at a cost of about $150,000.

Canada

VANCOUVER, B. C.—The City Council has instructed the fire and police committees of the Council to make investigations relative to the installation of a municipal electric power plant. Three water-power sites are under consideration. The committees have decided to ask for proposals for other developed and undeveloped water-power sites and have requested the city engineer to report on the development of the water-power on Capilano and Seymour Creeks owned by the city.

MULGRAVE, N. S.—The Mulgrave Pwr. Co. has applied to the Nova Scotia Legislature for a charter. The capital stock is placed at $50,000, and the company proposes to supply electricity for lamps, heaters and motors in Mulgrave and adjacent districts. The incorporators are: Wesley Hattie, of Mulgrave; D. McCarthy, of Sydney; Allen Kennedy and James Clark.

EXETER, ONT.—Plans are being prepared for the installation of a new hydroelectric system to cost about $30,000. A distribution system to supply electricity to neighboring towns is also under consideration. T. B. Carling is town clerk.

FORMOSA, ONT.—The Formosa El. Lt. Co., recently organized, proposes to erect a transmission line to connect with the lines of the Walkerton El. Lt. & Pwr. Co. at Mildmay. F. A. Heinz is president of the company.

HARRISTON, ONT.—J. H. Castor, engineer for the Hydro-Electric Power Commission of Ontario, has outlined a plan by which Harriston and other towns may obtain Hydro-Electric power from the commission. It is proposed to tap the Stratford-Goderich line near Mitchell, running through Milverton, Atwood, Listowel, Palmerston, Harriston and Clifford, provided that these towns will take power. Harriston would be required to take 200 hp at an approximate cost of $46 per year.

ORILLIA, ONT.—Tenders will be received by F. Gover, secretary and treasurer of the Orillia Water, Light and Power Commission, until May 17 for equipment for pumping station as follows: (A) Centrifugal pumps; (B) electric motors; (C) electrical equipment; (D) cast-iron flanged piping; (E) Venturi meter. Plans and specifications may be seen at the office of the commission. W. K. Greenwood is engineer.

RODNEY, ONT.—Plans are being considered by the Town Council, it is reported, for the installation of a hydroelectric power plant, to cost about $25,000.

TARA, ONT.—The Village Council is contemplating the installation of an electric plant. Electricity to operate the system will be obtained from the Toronto Hydro-Electric Power Commission.

TORONTO, ONT.—The Toronto Hydro-Electric Commission has purchased a reserved strip of land in connection with the new two-story substation to be erected at the corner of Gerrard Street and Carlow Avenue, to cost about $65,000. A branch Hydro-Electric shop will be established in this substation.

Miscellaneous

PEARL HARBOR, HAWAII.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until June 5 for electric-light fixtures for the naval hospital building, Naval Station, Pearl Harbor, Hawaii. Plans and specifications may be obtained on application to the bureau or to the commandant of the Naval Station, Honolulu.

PANAMA.—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until May 20, for furnishing dynamite, safety fuse, blasting caps, detonators, motor-driven fire and sewer pumps, cast-iron pipe and fittings, steel cable, boat spikes, track spikes, nails and screws, Babbitt metal, sheet brass, bronze bars, copper bars, brass tubing, copper tubing, sheet lead, lead pipe, solder, valves, cocks, water gages, ammeters, voltmeters, etc. Blanks and general information relating to this circular (No. 923) may be obtained at the above office or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Major F. C. Boggs is general purchasing officer.

MELBOURNE, VICTORIA, AUSTRALIA.—The Railway Commissioners invite firms which manufacture or sell meters, coasting recorders or other devices for keeping a check on the expenditure of electrical energy in train operation to submit particulars of appliances which are designed and applicable to railway trains operated on the multiple-unit system by means of direct current at 1500 volts. The particulars submitted, which should include a technical description of the apparatus, details of its operation and the approximate cost of equipment per car, must be submitted at the office of the Agent General for Victoria, Melbourne Place, Strand, W. C., London, Eng., not later than May 19. For details see proposal columns.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED APRIL 27, 1915.

[Prepared by Mitchell & Allyn, 41 Park Row, New York.]

1,136,929. UNIVERSAL FLOOR BOX; W. A. Bonnell, Brooklyn, N. Y. App. filed May 20, 1913. Two adjustable box sections, waterproof.

1,136,942. LAMINATED CORE FOR ELECTRICAL APPARATUS; E. B. Cutten, Erie, Pa. App. filed Sept. 23, 1913. Laminations slitted to break up eddy currents.

1,136,943. DYNAMO-ELECTRIC MACHINE; E. B. Cutten, Erie, Pa. App. filed Sept. 27, 1913. Special structure for either alternating current or direct current.

1,137,019. VOLTAGE REGULATOR; A. Pollak, Paris, France. App. filed July 18, 1912. For automobile lighting systems.

1,137,027. ELECTRICITY METER; G. A. Scheeffer, Indianapolis, Ind. App. filed Sept. 28, 1910. Armature has plurality of windings and independent magnetic cores.

1,137,030. DRY CELL; E. C. Smith, Toronto, Canada. App. filed Oct. 18, 1912. Provision for securely holding the compressed mixture in place.

1,137,044. KEYBOARD FOR PRINTING-TELEGRAPH APPARATUS; W. Zabel, Edgewood Borough, Pa. App. filed April 28, 1914. Prevents repetition of a signal in case a key is held in depressed position.

1,137,046. SECTIONING MEANS FOR ELECTRIC STATIONS PROVIDED WITH ACCUMULATORS; E. Brandenburg, Brussels, Belgium. App. filed Oct. 2, 1911. Minimizes disturbances.

1,137,050. ELECTRICAL COOKING DEVICE; F. E. Carlson, New Britain, Conn. App. filed Aug. 7, 1913. Mechanical structure of oven and structure of heater.

1,137,084. MECHANISM FOR CONTROLLING RAILROAD SIGNALS; A. H. Renshaw, Noroton, Conn. App. filed Oct. 6, 1913. Increased factor of safety

1,137,116. AUTOMATIC VEHICLE-TIRE SIGNAL; J. H. Brown, Midvale, Utah. App. filed Dec. 11, 1913. Gives signal when pressure is either too high or too low.

1,137,121. ELECTRIC REGULATION; J. L. Creveling, New York, N. Y. App. filed Dec. 29, 1910. Particularly for charging storage batteries.

1,137,146. PRINTING-TELEGRAPH APPARATUS; C. L. Krum, Chicago, Ill. App. filed Feb. 4, 1909. Can be employed either as a transmitter or a receiver.

1,137,150. COMPOSITE ELECTRIC SYSTEM; A. D. T. Libby, Elyria, Ohio. App. filed Aug. 28, 1909. Combined telephone, police and fire system.

1,137,151. COMPOSITE ELECTRIC SYSTEM; A. D. T. Libby, Elyria, Ohio. App. filed Jan. 28, 1910. Operates lamp signals at the substations over the conductors which are used for telephone purposes.

1,137,152. COMPOSITE ELECTRIC SYSTEM; A. D. T. Libby, Elyria, Ohio. App. filed Jan. 28, 1910. Two conductors for telephoning, signaling the main station, and for controlling operation of special signals at substations or patrolmen's boxes.

1,137,174 ELECTRICAL DISTRIBUTION SYSTEM; P. H. Thomes, East Orange, N. J. App. filed July 6, 1904. Mercury-vapor converter.

1,137,177. LOCKING DEVICE FOR ELECTRIC LAMP; H. T. Worrall, Chelmsford, England. App. filed Dec. 26, 1913. For locking bayonet-type lamps in their sockets.

1,137,186. TELEPHONE RECEIVER; J. J. Comer, Chicago, Ill. App. filed Oct. 24, 1910. Loud-speaking system for transmission of music, etc.

1,137,188. DIFFERENTIAL MICROPHONE REPEATER; J. J. Comer, Chicago, Ill. App. filed Feb. 13, 1911. For loud speaking; regulation of spring tension.

1,137,189. TRANSMITTING APPARATUS; J. J. Comer, Chicago, Ill. App. filed July 16, 1913. Compressions and rarefactions of air on opposite sides of diaphragm are both used.

1,137,193. MEANS OF COMBINED TELEPHONIC AND TELEGRAPHIC TRANSMISSION; P. B. Delaney, South Orange, N. J. App. filed March 17, 1911. Provides for dot-and-dash code signals over ordinary telephone line.

1,137,200. COMMON-BATTERY AUTOMATIC-TELEPHONE SYSTEM; W. L. Campbell, La Grange, Ill. App. filed July 9, 1907. Called subscriber's line receives talking current through medium of the normal connection therefrom to the common battery.

1,137,204. LAMP; A. B. Gates, Peterborough, Ontario, Canada. App. filed Nov. 10, 1914. Fitted to ordinary dry cell.

1,137,223. MACHINE TELEPHONE SWITCHING SYSTEM; F. R. McBerty, Antwerp, and L. Polinkowsky, Brussels, Belgium. App. filed March 2, 1914. Improved registering and controlling equipment.

1,137,226. ELECTROLYTE FOR PRIMARY BATTERIES; A. P. Manchester, Providence, R. I. App. filed Dec. 26, 1912. Alkaline characteristics, gelatinous nature and minimum causticity.

1,137,231. MACHINE TELEPHONE-SWITCHING SYSTEM; L. Polinkowsky, Brussels, Belgium. App. filed March 2, 1914. Power-driven registering and controlling devices.

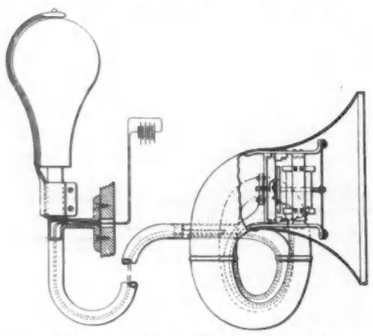
1,137,235. TELEPHONE RECEIVER; H. H. Schneider, Seattle, Wash. App. filed March 13, 1914. Permanent magnet secured to the diaphragm, with its poles adjacent to poles of an electromagnet.

1,137,239. COMBINED ELECTRIC AND PNEUMATIC HORN; W. Sparks, Jackson, Mich. App. filed Oct. 20, 1910. Bulb controls operation of pneumatic or electric horn.

1,137,275. FILAMENT FOR AUDIONS; A. McL. Nicholson, Tarrytown, N. Y. App. filed June 6, 1914. Twisted platinum ribbon with oxide coating.

1,137,295. ELECTRICAL CONNECTOR OR SOCKET; J. C. Stearns, Worcester, Mass. App. filed March 23, 1912. External cylindrical form so as to be insertable into a bored hole.

1,137,309. OIL SWITCH; L. Fleischmann and A. Elfes, Berlin, Germany. App. filed Oct. 11, 1912. Prevents glowing particles coming into contact with combustible gases at the surface of the oil.



1,137,239—Combined Electric and Pneumatic Horn

1,137,315. SYSTEM FOR THE TRANSMISSION OF INTELLIGENCE; R. A. Heising, East Orange, N. J. App. filed Nov. 14, 1914. Two thermionic repeaters in series.

1,137,333. FLEXIBLE CLAMP JOINT; C. P. Klorer, East Conemaugh, Pa. App. filed March 9, 1914. For portable lamps.

1,137,337. MINING MACHINE AND TRUCK; N. D. Levin, Columbus, Ohio. App. filed Aug. 31, 1910. Mining mechanism can be separated from the truck.

1,137,340. CIRCUIT INTERRUPTER; C. Lichtenberg, Schenectady, N. Y. App. filed Oct. 11, 1912. Has means just below the surface of the oil for cooling the products of the arc.

1,137,352. RHEOSTAT; G. B. Reisbach, Milwaukee, Wis. App. filed May 6, 1914. Clamping means for the control levers.

1,137,360. TELEPHONE SYSTEM; C. Smith, Cleveland, Ohio. App. filed April 4, 1911. Semi-automatic.

1,137,372. TELEPHONE-EXCHANGE SYSTEM; J. L. Wright, Washington, D. C. App. filed March 23, 1912. Improved means for controlling the automatic switching mechanism.

1,137,384. SYSTEM FOR THE TRANSMISSION OF INTELLIGENCE; E. H. Colpitts, East Orange, N. J. App. filed May 18, 1914. Has repeater which serves as generator of high-frequency oscillations and also as means for modulating the oscillations.

1,137,393. MEDICAL APPLIANCE; N. T. Fogg, Sanford, Maine. App. filed Feb. 6, 1915. For throwing rays of sunlight into the throat.

1,137,413. METERING PANELBOARD; A. C. McWilliams, Chicago, Ill. App. filed April 25, 1910. Economizes space, reduces liability of short-circuit, and renders apparent the various meter and circuit groupings.

1,137,427. APPOINTMENT ANNOUNCER; S. R. Schaff, Louisville, Ky. App. filed Dec. 8, 1914. Operates signal upon arrival of the appointment; bearing strip at predetermined point.

1,137,474. SELECTIVE SIGNALING APPARATUS; E. R. Gill, Yonkers, N. Y. App. filed Oct. 21, 1910. High-speed selector for telephones.

1,137,475. SELECTIVE SIGNALING APPARATUS; E. R. Gill, Yonkers, N. Y. App. filed March 28, 1912. For returning the selectors to normal.

1,137,478. DEVICE FOR DETECTING MECHANICAL VIBRATION; F. Gottschalk, Stirling, N. J. App. filed Jan. 15, 1914. Varies the current flow by the direct action of mechanical vibrations.

1,137,479. RESISTANCE CELL FOR TRANSMITTERS; F. Gottschalk, Stirling, N. J. App. filed Feb. 13, 1914. Has diaphragm with the large area free to vibrate.

1,137,489. MOLDING; C. Jellinek, New York, N. Y. App. filed April 1, 1914. Ordinary wooden molding with a metallic facing.

1,137,492. MAGNETIC SEPARATOR; A. H. Kidney, Orange, N. J. App. filed Aug. 18, 1914. For testing magnetic sands, carrying platinum and gold.

1,137,510. DYNAMO-ELECTRIC MACHINE; E. Mattman, Milwaukee, Wis. App. filed Oct. 6, 1909. Fan arrangement for cooling the windings and structure.

1,137,513. ELECTRIC HEATER; W. A. Miller, New York, N. Y. App. filed Jan. 31, 1914. For heating contents of a coffee-pot, etc.

1,137,524. PROCESS OF PRODUCING CARBONITRIDES; S. Peacock, Chicago, Ill. App. filed Feb. 14, 1912. For chemically fixing nitrogen.

1,137,544. TONE-PRODUCING MEANS; M. L. Severy, Arlington Heights, and G. B. Sinclair, Medford, Mass. App. filed Feb. 25, 1910. Improved means employing current interruptions or alternations.

1,137,557. X-RAY APPARATUS; H. F. Waite, New York, N. Y. App. filed Feb. 18, 1913. For controlling alternating current of given frequency to have the effect in an X-ray tube of one or more currents of less frequency.

1,137,559. METALLURGICAL FURNACE; U. Wedge, Ardmore, Pa. App. filed Feb. 25, 1913. Provides for effective heating of the hearth.

1,137,567. MANUFACTURE OF CALCIUM CARBIDE; F. M. Becket, Niagara Falls, N. Y. App. filed Jan. 20, 1915. Charge is agglomerated into mechanically strong aggregates.

1,137,568. LAMP CARRIER; T. Birath, Jersey City, N. J. App. filed Oct. 1, 1914. Attached to dry cell.

1,137,573. PYROGRAPHIC NEEDLE; M. R. Carr, Corte Madera, Cal. App. filed Sept. 23, 1914. Electrically heated and has guard to prevent burning of fingers.

1,137,609. INITIAL SPARKER FOR GAS ENGINE MAGNETOS; L. Haggblom, Los Angeles, Cal. App. filed Dec. 26, 1913. When engine is cranked magneto produces initial spark to start engine without use of battery.

1,137,610. CIRCUIT CONTROLLER; C. I. Hall, Chicago, Ill. App. filed Sept. 25, 1911. For use with printing attachments of power wattmeters.

1,137,614. AMPLIFIER FOR TELEPHONES; R. D. Hatch, Memphis, Tenn. App. filed Dec. 7, 1914. Has means for attachment to ordinary receiver.

1,137,634. ELECTRICAL PLUG AND RECEPTACLE; W. R. Kelting, New York, N. Y. App. filed March 5, 1913. Floor box, with means for excluding dirt.

1,137,660. AUTOMATIC ELECTRICALLY ACTUATED TRAIN-CONTROLLING SYSTEM; E. L. Orcutt (deceased), Somerville, Mass. App. filed July 9, 1909. Employs a current-carrying rail.

1,137,674. RAIN INDICATOR; C. E. Smith, Brownsburg, Ind. App. filed April 15, 1914. Attachable to outside of window.

1,137,677. SETTING DEVICE; W. F. Straub, Chicago, Ill. App. filed Dec. 9, 1912. For setting secondary clocks.

1,137,705. AUTOMATIC BLOCK-SIGNALING SYSTEM FOR ELECTRIC RAILWAYS; S. M. Day, Rochester, N. Y. App. filed Oct. 8, 1908. Applicable to steam or electric railways.

1,137,714. SOLID RECTIFIER FOR FEEBLE ELECTRIC CURRENTS; G. W. Pickard, Amesbury, Mass. App. filed March 9, 1907. Mechanical holder for oscillation-detecting means.

1,137,717. CALL BOX; C. S. Rhoads, Jr., Chicago, Ill. App. filed April 28, 1913. Special means for sending the release impulse.

13,906 (reissue). MEANS FOR MAINTAINING VAPOR CONVERTERS IN OPERATION; P. H. Thomas, Upper Montclair, N. J. App. filed Aug. 7, 1914. (Original application filed Dec. 24, 1903, Series No. 186,488.) For storage-battery-charging systems.